



**Former Ore Mill
Natural Resources Park Site
Analysis of Brownfield Cleanup Alternatives
ADEQ Voluntary Remediation Program (VRP)
Site No. 508175-00
Tucson, Arizona**

Prepared for:

**City of Tucson
Tucson, Arizona**

Submitted by:

**AMEC Earth & Environmental, Inc.
Tempe, Arizona**

December 11, 2008

AMEC Job No. 08-114-03013

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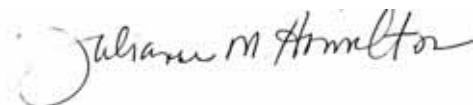
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A handwritten signature in black ink, reading "Julianne M. Hamilton".

Julianne M. Hamilton
Project Manager

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LIST of ACRONYMS and TERMS

Acronym/Term	Definition
AAC	Arizona Administrative Code
ABCA	Analysis of Brownfield Cleanup Alternatives
ADEQ	Arizona Department of Environmental Quality
AMEC	AMEC Earth & Environmental
AZPDES	Arizona Pollutant Discharge Elimination System
bgs	below ground surface
BMPs	Best Management Practices
CFR	Code of Federal Regulations
CGP	Construction General Permit
COCs	Constituents of Concern
COT	City of Tucson
CSM	Conceptual Site Model
CWA	Clean Water Act
cy	cubic yards
DEUR	Declaration of Environmental Use Restriction
EPA	Environmental Protection Agency
ES	Environmental Services
ESA	Environmental Site Assessment
HAZWOPER	Hazardous Waste Operations and Emergency Response
LDR	Land Disposal Restrictions
LUCs	Land Use Controls
mg/kg	milligrams per kilogram
NFA	No Further Action
NPV	Net Present Value
O&M	Operation and Maintenance
PPE	Personal Protection Equipment
RAO	Remediation Action Objectives
RCRA	Resource Conservation and Recovery Act
ROM	Rough Order of Magnitude
rSRL	residential Soil Remediation Level
site	Natural Resources Park Site
SWPPP	Storm Water Pollution Protection Plan
TCLP	Toxicity Characteristic Leaching Procedure
VRP	Voluntary Remediation Program
XRF	X-Ray Fluorescence

EXECUTIVE SUMMARY

This Analysis of Brownfield Cleanup Alternatives (ABCA) report has been developed to present an evaluation of remedial action alternatives for the former ore mill site. The plan for redevelopment of the property is to create a natural resources park. The park design will be compatible with the remedial design of the property. The property is an approximately 30-acre lot located west of Silverbell Road and north of Speedway Boulevard in Tucson, Pima County, Arizona (Pima County Parcel Number 115-10-0090). An ore mill operated on the property to beneficiate tungsten ore during World War II.

Environmental investigations were performed at the property which detected metals in soil at concentrations exceeding Arizona Department of Environmental Quality (ADEQ) residential soil remediation levels (rSRLs) for lead concentrations (ADEQ rSRL of 400 mg/kg), arsenic (ADEQ rSRL of 10 mg/kg), and cadmium (ADEQ rSRL of 38 mg/kg). The horizontal and vertical extent of arsenic and cadmium impacted materials are contained within the boundaries of lead impacted materials. Approximately 7,500 cubic yards of soil is estimated to exceed the lead rSRL. Soil exceeding the lead rSRL should be removed and/or isolated to mitigate risk associated with direct human contact. As the material impacted with arsenic and cadmium is present within the boundaries of the materials exceeding the rSRL for lead, these actions also would mitigate arsenic and cadmium impacted soils.

Four remedial alternatives (Alternatives 1 through 4) were developed by assembling combinations of remedial technologies to mitigate the impacted soil that were retained through preliminary screening. These alternatives are presumptive remedies from EPA's scientific and engineering evaluation of performance data on technology implementation. Aside from taking no action, the remedial alternatives ranged in cost from \$153,000 to \$1,845,000 and varied in implementability and protectiveness.

Alternative 3a is the recommended remedial action alternative for the property because it is protective, has a sufficient degree of effectiveness and long-term reliability, is implementable, and is moderately cost effective (cost per cubic yard remediated) in comparison to the other alternatives. Alternative 3a consists of excavating material on the north slope of the former ore mill structure and the area south of the former ore mill structure exceeding the 400 mg/kg rSRL for lead. The above existing grade building foundations would be demolished. The excavated materials and demolished concrete would be placed in an excavated pit on the east side of the former ore mill structure. A 2.5-foot engineered soil cap would be installed over the remaining contamination footprint and the pit, using material from an off-site source. The borrow pit material would be used to backfill the flat area on the south end and the north slope and the surrounding topography would be modified to create 1 - 2 percent graded side slopes from the capped area.

1.0 INTRODUCTION

This Analysis of Brownfield Cleanup Alternatives (ABCA) report has been developed to present an evaluation of remedial action alternatives for the former ore mill site. The City of Tucson (COT) entered the former ore mill site into the ADEQ Voluntary Remediation Program (VRP) under site number 508175-00. The ABCA is based on the potential future site development goal of creating a natural resources park. The ABCA utilizes information obtained from remedial investigations to evaluate remedial action alternatives that address constituents of concern (COCs) present in soil at concentrations greater than risk screening values. These screening values consider human direct exposure (dermal, ingestion and inhalation) to metals impacted soil at the former ore mill site. A recommendation for a preferred remedial alternative is provided in Section 13 of this ABCA report.

2.0 BACKGROUND

2.1 Site Description

The property is an approximately 30-acre lot located west of Silverbell Road and north of Speedway Boulevard in Tucson, Pima County, Arizona (Pima County Parcel Number 115-10-0090). The legal description of the property is the SW ¼ of Section 3, Township 14 South, Range 13 East of the Gila and Salt River Meridian on the Cat Mountain Quadrangle, Arizona (See Figure 1). The property is rectangular in shape and is bounded to the north by Anklam Wash.

The following features associated with the former ore mill remain on the property (See Figure 2):

- Two concrete structures (assumed former settling basins) and the concrete footings for a structure that contained at least four rooms.
- Possible ore piles located between a concrete slab and a small pit next to the footings.
- A circular slab for a former water tank and a small brick foundation.
- Possible ore fragments (dark gravel) located on each side of the dirt road south of the mill.

2.2 Historical Tungsten Mill Operation

An ore mill operated on the property to beneficiate tungsten ore during World War II. Knowledge of past operations at the property comes from a cultural resources report prepared by Desert Archeology in 2006 for the City of Tucson. A summary of past operations at the property is provided below.

During World War II, Arthur Jacobs of Jacobs Assaying, a Tucson firm founded in 1880, was contracted by the U.S. Military to beneficiate tungsten at an ore mill within the project area. Arthur Jacobs Jr., only 4 years old when World War II began, remembers the mill was operated under great secrecy; he does not know how or where the tungsten was initially mined. He does remember a series of flotation tables in the facility, but little else. It is not clear whether the mill was used much after World War II (Desert Archaeology, 2006).

Actual information about the on-site operations is not available, but in 1993, George Teague, an archaeologist at the National Park Service's Western Archaeological and Conservation Center, was consulted to speculate on the ore mill operation.

It appears that ore was brought to the former ore mill site from another location. The equipment mounts probably held grinding or stamping mills that reduced the ore in size. Ore was probably introduced through a large hoist and initial grinding took place. Then the ore was transferred to another area for further reduction. A large coal-fired electrical generator or steam boiler was probably used on-site and stood on huge mounts and was fed coal stored in a large pit south of the building. This pit is now filled with beneficiated rock from which ore was removed.

Once ground into finer materials, the ore was probably mixed with water and carried through large iron pipes into the two settling tanks on the western side of the complex. There, chemicals may have been added to aid in ore extraction. It is unknown whether chemical extraction was used to beneficiate tungsten ore at the former ore mill site. No known smelting processes occurred at the former ore mill site.

Excess water was drained through pipes into the adjacent wash. The ore was extracted and may have been taken from the former ore mill site via a now eroded road that passed over the wash. A set of concrete piers located on the northern side of the complex may have bridged the wash. The complex was probably not in operation for a long period of time, because there are not large quantities of slag or tailings, with the exception of the pit on the southeastern side of the complex.

Located east of the ore mill complex is a boulder foundation that is the remains of a dwelling that once stood on the property. The building post-dates the construction of the Elk's Hospital in 1954, an aerial photograph shows the dwelling had been removed from the site by 1971. Today, the remains of the home are roughly L-shaped and consist of a foundation area filled with dirt and gravel to a height of about 3 feet above the surrounding area. No artifacts are associated with this feature (Desert Archaeology, 2006).

3.0 SUMMARY OF SITE CHARACTERIZATION

COT sold the subject property on May 1, 1943 and re-purchased the property on July 29, 1969 (Desert Archaeology, 2006). Ore mill operations, which are believed to have caused the elevated metals concentrations in the site soil, were believed to have been initiated sometime during WWII. In 2006, COT began considering the property for recreational use. As such, it prompted the need for environmental investigations to assess the extent of impact from historical ore mill operations at the property. Three separate phases of environmental investigations were performed by Kleinfelder under contract to COT between 2006 and 2008. Figures 3 and 4 show the location of discrete soil samples and sector corners for composite samples, with sample identification numbers indicated at each location. A copy of the analytical results from the Kleinfelder investigations is presented in Appendix A. The following sections summarize the results.

July 2006 Sampling

The first phase of environmental sampling was conducted in July 2006 to evaluate metals concentrations in soil, sediment, and ore-related samples. Samples were collected at 18 locations, from a depth of 0.5-1.0 feet below ground surface (bgs) using a stainless steel hand auger and pick axe. Soil samples were analyzed using EPA Method 6010/7471 for Resource Conservation and Recovery Act (RCRA) 8 Metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury) and tungsten. During the July 2006 sampling investigation, metals were detected in soil at concentrations exceeding Arizona Department of Environmental Quality (ADEQ) residential soil remediation levels (rSRLs), as summarized below.

- Lead concentrations ranged from less than 25 milligrams per kilogram (mg/kg) (sample S-15) to 28,000 mg/kg (sample S-4). A total of 15 samples exceeded the ADEQ rSRL of 400 mg/kg for lead.
- Arsenic ranged from less than 25 mg/kg (in background samples S-17 and S-18) to 1,500 mg/kg (SB-5). A total of 15 samples exceeded the ADEQ rSRL of 10 mg/kg for arsenic.
- Cadmium concentrations ranged from less than 2.5 mg/kg (S-15) to 43 mg/kg (S-18). Two (2) samples exceeded the ADEQ rSRL of 38 mg/kg for cadmium.
- Concentrations of tungsten ranged from less than 10 mg/kg (S-5 and S-15) to 6,100 mg/kg (S-16). There is currently no ADEQ rSRL established for tungsten.

August/September 2006 Sampling

Follow-up sampling was conducted during August and September 2006 to delineate the horizontal extent of the known impacted areas and to identify other potential areas of concern. During the August/September 2006 investigation, 48 soil samples were collected and submitted for laboratory analysis of RCRA 8 Metals. In addition, an X-Ray Fluorescence (XRF) survey was conducted adjacent to Anklam Wash, and eight (8) confirmation samples were submitted to the laboratory to verify the reliability of the XRF survey results. The following summarizes the results of the August/September 2006 sampling investigations (Kleinfelder, 2006b and c).

Soil Sample – Laboratory Analysis

- Lead concentrations ranged from 9.8 mg/kg (S-51) to 22,000 mg/kg (S-47). Twelve (12) of the 48 soil samples collected for laboratory analysis exceeded the ADEQ rSRL of 400 mg/kg for lead.
- Arsenic concentrations ranged from less than 5 mg/kg (S-39) to 450 mg/kg (S-39). Nine (9) of the 48 soil samples collected for laboratory analysis exceeded the ADEQ rSRL of 10 mg/kg for arsenic.
- Barium, cadmium, chromium, selenium, silver, and mercury were not detected at or above their respective rSRLs.

XRF Survey

- A total of 93 surface soil samples were field screened using a portable XRF instrument.
- Lead concentrations ranged from less than 14 mg/kg (JS-25) to 9,003 mg/kg (JS-29). A total of 37 soil samples exceeded the ADEQ rSRL of 400 mg/kg for lead.
- Arsenic concentrations ranged from less than 12 mg/kg (C-6) to 1,271 mg/kg (JSa-41). Six (6) soil samples exceeded the ADEQ rSRL of 10 mg/kg for arsenic.
- Concentrations of cadmium ranged from non-detect to 122 mg/kg (JS-31). Three (3) soil samples exceeded the ADEQ rSRL of 38 mg/kg for cadmium.
- Laboratory confirmation sampling verified results reported for the XRF screening.

The following conclusions were made following the August/September 2006 sampling investigation (Kleinfelder, 2006b and c).

- The surface area with concentrations at or above the ADEQ rSRL for lead is approximately two (2) acres, and encompasses the former ore mill building foundations and the immediate periphery.
- Two (2) isolated areas (S-47 and S-48) also were identified as exceeding the ADEQ rSRL for lead.

- Areas exceeding arsenic and cadmium ADEQ rSRLs are present within the areas of lead exceedences.
- Arsenic was detected in Sample S-52, at a concentration of 11 mg/kg, at the west property boundary. This concentration is considered to be representative of background conditions.

May 2007 Sampling

Additional environmental investigation was conducted in 2007 to refine the horizontal extent of contamination at the property and to delineate the vertical impacts of arsenic, cadmium, and lead. The main goal of the investigation was to estimate the volume of soil exceeding rSRLs. The following additional conclusions were made following the May 2007 sampling investigation (Kleinfelder, 2008b). In general, arsenic and cadmium exceedences coincide with lead exceedences.

August 2008 Sampling

Additional sampling was conducted at the stock piles located northeast of the former building foundations to define the western and southern edges of the piles. Two additional soil samples were collected from 0 to 0.5 feet bgs, samples S901 and S902. Sample results indicated the following:

- Arsenic and cadmium were detected at concentrations below the detection limit at sample locations S901 and S902.
- Lead concentrations were detected at 20 and 13 mg/kg at sample locations S901 and S902, respectively.

The lateral and vertical extent of lead, cadmium, and arsenic impacted soil has been adequately characterized to a depth of approximately five (5) feet bgs at the southern portion of the property (ADEQ, 2008). Areas of auger refusal at the former building foundations define an area that has not been completely delineated. Further delineation in this area may be conducted during remediation activities through the collection of confirmation samples, and or may be addressed with a remedial option of capping (ADEQ, 2008a; COT, 2008, Kleinfelder, 2008b). The auger refusal areas have been incorporated into the remedial action alternatives presented in Section 10.

4.0 LAND USE DETERMINATION

The site and the area immediately surrounding the former ore mill site are currently zoned residential (Figure 5).

5.0 PLANNED REDEVELOPMENT ACTIVITIES

The plan for redevelopment of the property is to create a natural resources park. The park design will be compatible with the remedial design of the property.

6.0 APPLICABLE REGULATIONS

Applicable requirements are those environmental cleanup standards, requirements, criteria, or limitations promulgated under federal, state, or local law that specifically address the circumstances at an environmental cleanup site. If the requirement is not legally applicable, the requirement is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those environmental cleanup standards, requirements, criteria, or limitations promulgated under federal, state, or local law that, while not applicable, address problems or situations similar to the circumstances of the proposed response action and are well suited for the conditions of the site.

This ABCA has been prepared to be consistent with state, federal and local environmental regulations. A summary of potential applicable regulations for the remediation alternatives evaluated at this property is presented in Table 1. Identification of regulatory applicability is necessary for determining cleanup goals, selecting a remedy, and determining how to implement the remedy, while protecting human health and the environment. The regulatory standards may be categorized as follows.

Chemical-specific Applicability - define acceptable exposure levels, usually health- or risk-based concentrations for specific chemicals, and may be used to establish preliminary remediation goals. Examples for this project could include Arizona soil remediation levels and OSHA occupational health exposure limits to lead, arsenic and cadmium.

Location-specific Applicability - requirements established by geographical location or land use concerns. Examples for this project could include the restriction of construction activities and discharging dredged or fill material within flood plains, sensitive ecosystems or habitats, or Waters of the U.S., per Section 404 of the Clean Water Act (CWA).

Action-specific Applicability - requirements that may set controls or restrictions for particular treatment or disposal activities for the proposed response. Examples may include permit limits for discharging wash water, or values specific for placement or disposal of soils in compliance with federal RCRA Land Disposal Restriction (LDR) rules, Arizona solid waste management regulations, and Pima County dust control rules and permit conditions.

7.0 CONSTITUENTS OF CONCERN

The COCs at the former ore mill site were identified by screening soil concentrations against ADEQ rSRLs. The COCs are arsenic, cadmium, and lead, which all were detected at concentrations greater than their respective ADEQ rSRL. Tungsten also was detected at the property, but there is not currently an rSRL or a federal standard established for tungsten. Information presented in the environmental investigation reports (Kleinfelder 2008b and 2006a,b,c) demonstrate soil is the only medium at the property with COCs at concentrations greater than rSRLs. Groundwater, which is present at a depth of approximately 100 feet bgs, was sampled by the COT at a monitoring well in El Rio Park, east of the site, in 2006. The COCs in the groundwater sample were reported as below the detection limits (COT, 2006).

8.0 CLEANUP GOALS AND OBJECTIVES

Arizona's cleanup regulations require that contaminants be managed to prevent unacceptable risks to human health and the environment. For the former ore mill site, any soil with concentrations exceeding the rSRL values established for arsenic, cadmium and lead of 10 mg/kg, 38 mg/kg and 400 mg/kg, respectively, may be indicative of an unacceptable risk through direct contact with soil for residential uses of soil.

The cleanup goals for the property include:

1. Prevent direct human contact with soil that contains lead, arsenic and/or cadmium at concentrations exceeding rSRLs; and
2. Reduce the potential for metals to leach into groundwater and surface water.

Direct contact with soil can occur through: 1) dermal contact with COCs in soil, 2) ingestion of COCs in soil, and 3) inhalation of COCs in dust.

The horizontal and vertical extent of arsenic and cadmium impacted materials are contained within the boundaries of lead impacted materials. Approximately 7,500 cubic yards of soil is estimated to exceed the lead rSRL. Soil exceeding the lead rSRL should be removed and/or isolated to mitigate risk associated with direct human contact. As the material impacted with arsenic and cadmium is present within the boundaries of the materials exceeding the rSRL for lead, these actions also would mitigate arsenic and cadmium impacted soils.

9.0 ABCA SCOPING

The ABCA scoping process consists of developing a conceptual site model (CSM), establishing remedial action objectives (RAO) and treatment standards, calculating the quantities for treatment, and identifying the evaluation screening criteria applicable to the property. Each of these steps is described in more detail below.

9.1 Conceptual Site Model

A CSM has been developed for the property utilizing previously collected information to identify potentially complete exposure pathways. Potential risk pathways are evaluated using four components. All four components must be present in order for the pathway to be considered complete and result in receptor exposure. These components are:

1. A potential source and mechanism of hazardous release (e.g. historic practices, etc.);
2. A retention or transport medium (e.g., soil, air, etc.);
3. A point of potential receptor contact with the impacted medium, referred to as the exposure point (e.g., exposed soil, utility work, etc.); and
4. A potential receptor exposure route (e.g., dermal contact or ingestion of impacted soil).

Soil at the former tungsten ore mill site contains lead, arsenic, and cadmium at concentrations greater than ADEQ rSRLs. If the land were developed as a park without any remedial actions then a complete exposure pathway would exist.

9.2 Remedial Action Objectives

Remedial Action Objectives (RAOs) for the property have been developed to protect receptors and provide the underlying basis for developing and evaluating remedial actions. Arizona Administrative Code (AAC) R18-7-203.B states that all remediation must be completed so that contaminant concentrations remaining at the property are protective of groundwater, are not characterized as hazardous wastes, and do not threaten exposed receptors. The RAOs for the property include the following:

1. Prevent direct contact by human receptors with soil that has lead concentrations greater than rSRLs. For the property, any soil with concentrations exceeding the rSRLs for lead of 400 mg/kg may be indicative of an unacceptable direct contact risk. Mitigating soil containing lead at a concentration exceeding rSRLs also would result in mitigation of arsenic and cadmium;
2. Prevent mechanical transportation of soil with lead concentrations greater than primary screening values into occupational and residential areas and structures; and
3. Prevent transport of lead from soil/source materials to groundwater at concentrations that would exceed human health exposure criteria.

9.3 Quantity Estimates

The volume of soil at the property potentially requiring remedial action was estimated by reviewing the soil analytical results and estimating the areas with concentrations of lead greater than 400 mg/kg. Arsenic and cadmium were only detected within the footprint of soil containing lead concentrations greater than 400 mg/kg.

To estimate soil volumes, soil analytical results were separated into five depth intervals, 0 to 1, 1 to 2, 2 to 3, 3 to 4, and 4 to 5 feet bgs at the property (see Figure 6). The area and soil thickness were used to estimate the soil volume using the rectangular solid formula (length x width x height). The estimated amount of impacted soil at the property is approximately 7,500 cubic yards.

10.0 DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

The ABCA requires an assessment of the remedial alternatives in terms of protectiveness, effectiveness, long-term reliability, implementability, the risk of implementation, and the reasonableness of cost. Protectiveness is typically a qualitative assessment of the adequacy and reliability of engineering and/or institutional controls in managing risk over the long-term. Viable site cleanup technologies were combined into five remedial alternatives for further evaluation as summarized in Table 2.

Five remedial alternatives were developed by assembling combinations of remedial technologies that were retained through preliminary screening. These alternatives are presumptive remedies from EPA's scientific and engineering evaluation of performance data on technology implementation for soil remediation. Design assumptions and unknowns associated with each alternative are shown in Table 2.

10.1 Alternative 1: No Action

No action would be performed at the property under Alternative 1 beyond the actions COT has already taken with the placement of fencing and signage. The impacted soils would be left in place without any additional remedy.

10.2 Alternative 2: Engineering and Land Use Controls

Alternative 2 includes the utilization of engineering and LUCs to manage materials at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The existing fence would be left around the 2.1 acre portion of the property containing waste and/or minimizing the footprint of the waste area and then replacing the fencing.

The engineering controls that would be implemented in Alternative 2 are:

- A 6-foot chain link fence.
- Appropriate permanent erosion and sediment control BMPs would be installed at the slope face to prevent sediment erosion down the slope and into the wash adjacent to the property.
- Long-term dust monitoring.

The fenced area would not be open to the public. Therefore, park design would need to prevent access to this area, perhaps utilizing landscaping to detour attention away from the closed area.

Alternative 2 will also require the implementation of land use controls (LUCs) to limit human exposure by restricting activity, use and access to the property for day use recreational activities. In addition, a Declaration of Environmental Use Restriction (DEUR) would need to be applied for and placed on the deed to the property. The DEUR (approved and granted by ADEQ) prevents any potential future residential development under the ownership of COT or any future property owner that would pose unacceptable exposure to the impacted soil.

In accordance with the engineering control plan and the DEUR requirements, Alternative 2 would also require routine inspection, monitoring and maintenance, if necessary, of the site. The inspection/monitoring would consist of inspecting site for signs of erosion, fence integrity (or signs of trespassing inside the fence), and collecting an 8-hour air sample of COCs at the site. An annual report would be prepared and submitted to ADEQ documenting the inspection and maintenance, documenting compliance with the DEUR conditions. ADEQ reserves the right to inspect and take enforcement action if the conditions of the DEUR are not adequately maintained. The DEUR (and associated inspection and maintenance) remains in effect until the COT or other future property owner demonstrates that the DEUR can be released (i.e., there is no longer potential for human receptor exposure to impacted soils).

10.3 Alternative 3: Excavate and Control On-Site

Alternative 3 consists of excavating and consolidating portions of the contamination footprint to a single location at the site, either to an excavated pit (Alternative 3a) or within the former building foundations and other nearby existing depressions (Alternative 3b). As described below, Alternatives 3a and 3b differ in the areas and volumes of the contamination footprint that are excavated, the type of protective cover or cap installed, the resulting topography, and the follow-up inspection, monitoring, and maintenance required.

10.3.1 Alternative 3a: Excavate, Bury On-Site and Engineered Cap

Alternative 3a involves the excavation of material on the face of the slope north of the former ore mill structure and the area south of the former ore mill structure exceeding the 400 mg/kg rSRL for lead. The above existing grade building foundations would be demolished. The excavated materials and demolished concrete would be placed in an excavated pit on the east side of the former ore mill structure. A 2.5 foot engineered soil cap would be installed over the remaining contamination footprint and the pit, using material from an off-site source. The borrow pit material would be used to backfill the flat area on the south end and the north slope and the surrounding topography would be modified to create 1 - 2 percent graded side slopes from the capped area.

Test pits would be excavated and soil samples would be collected on the north slope to confirm the depth of impacted soils and to determine the required volume of the borrow pit. Excavation on the north slope are expected to occur to depths ranging from one (1) to five (5) feet bgs and one (1) to two (2) feet bgs on the south area, based on soil sample results from the environmental investigations summarized above in Section 6. The excavation area is depicted in Figure 7. Confirmation soil samples would be collected to verify all soil with a lead concentration greater than 400 mg/kg has been excavated. Confirmation soil samples will be analyzed for total lead by Method 6010/7471. Approximately 5,500 cubic yards of material would be excavated from the face of the north slope and the area south of the former ore mill structure. All excavation activities and soil handling would be conducted using appropriate best management practices (BMPs) with an approved site-specific Storm Water Pollution Protection Plan (SWPPP), to prevent and/or minimize the discharge of pollutants under the Arizona Pollutant Discharge Elimination System (AZPDES) Construction General Permit (CGP) administered by ADEQ. In addition, all fugitive dust would be controlled per Pima County dust permit requirements and air monitoring would be conducted to ensure nearby residential and worker safety in accordance with a site-specific health and safety plan.

The results from the previous environmental investigations indicate the material containing lead at a concentration greater than the rSRL of 400 mg/kg is either residual unbeneficiated tungsten ore or tailings. Mine ore and tailings are exempt from being classified as a RCRA hazardous waste per 40 CFR 261.4. This regulation, specifically the Bevill Exclusion to RCRA, excludes mine and beneficiation wastes and 20 specific types of mineral processing wastes from hazardous waste regulations (EPA, 2008). Milling of ore is considered a beneficiation of mine material. The unbeneficiated tungsten ore and tailings observed at the former ore mill site are not considered a hazardous waste and can be managed at the property as a waste. Managing the mining wastes on the property will be a more cost effective, timely, and sustainable means of managing the materials.

The above existing grade building foundations would be demolished and placed in the pit along with the excavated material. The pit would be placed on the east side of the former ore mill structure. The actual footprint and dimensions of the pit will be determined once the depths of impacted soils on the north slope are confirmed from the test pits. A more detailed topographic aerial survey, to a resolution of 0.5 foot, would be obtained in the site to accurately plan for the remediation and grading design needed in this alternative.

A demarcation layer would be placed over the impacted soil within the contamination footprint and the pit, followed by an engineered soil cap. The cap would consist of an approximately 2.5 foot homogeneous layer of clean soil (silty to sandy gravel free of calcium carbides), likely from an off-site source. Capping minimizes exposure of impacted soil to human receptors, and reduces the rate of precipitation infiltrating through the impacted soil. The borrow pit material would be used to backfill the flat area on the south end and the north slope and the surrounding topography would be modified to create 1 - 2 percent graded side slopes from the capped area and drainage channels on the west, south and east sides of the cap. The soil surface could be restored with short-rooted native vegetation in conjunction with the park design.

Alternative 3a would require the implementation of engineering controls and LUCs. The installation of a demarcation layer and the engineered cap all are engineering controls that would be utilized to prevent human exposure to consolidated materials. In addition, a stormwater drainage design plan would prevent erosion of the cap and prevent infiltration of storm water into consolidated materials. A LUC would need to be established to limit human exposure by restricting activity, use, and access to the property for day use recreational activities. In addition, a DEUR would need to be applied for and placed on the deed to the property. The DEUR (approved and granted by ADEQ) prevents any potential future residential development under the ownership of COT or any future property owner that would pose unacceptable exposure to the impacted soil.

In accordance with the engineering control plan and the DEUR requirements, Alternative 3a would also require inspection, monitoring, and maintenance of the engineered cap to ensure that the direct contact with impacted materials to human receptors is prevented. The surface of the engineered cap should be inspected for signs of cracking, stormwater ponding, differential settlement, exposed impacted material, erosion and wildlife burrows. An annual report would be prepared and submitted to ADEQ documenting the inspection and maintenance, documenting compliance with the DEUR conditions. ADEQ reserves the right to inspect and take enforcement action if the conditions of the DEUR are not adequately maintained. The DEUR (and associated inspection and maintenance program) remains in effect until the COT or other future property owner demonstrates that the DEUR can be released (i.e., there is no longer potential for human receptor exposure to impacted soils).

Alternative 3a would meet the site-specific RAOs by reducing the risk of direct contact with impacted materials for human receptors.

10.3.2 Alternative 3b: Excavate, Consolidate, and Cap

Alternative 3b involves the excavation of material at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The excavated materials would be consolidated and placed in the former building foundations and other existing depressions nearby and capped with soil and an impervious (i.e. concrete, asphalt) material. Demolition may be necessary to prepare the area for grading and the eventual soil and asphalt or concrete cap.

The majority of soil with a lead concentration greater than the ADEQ rSRL of 400 mg/kg would be excavated. Excavation would occur to depths ranging from one (1) to five (5) feet bgs, based on soil sample results from the environmental investigations summarized above in Section 6. The excavation area is depicted in Figure 8. Confirmation soil samples would be collected to verify all soil with a lead concentration greater than 400 mg/kg has been excavated. Confirmation soil samples will be analyzed for total lead by Method 6010/7471. Approximately 6,000 cubic yards of material would be excavated from around the former mill building foundations and then consolidated into the former mill building foundations. All excavation activities and soil handling would be conducted using appropriate BMPs with an approved site-specific SWPPP to prevent and/or minimize the discharge of pollutants under the AZPDES CGP administered by ADEQ. In addition, all fugitive dust would be controlled per Pima County dust permit requirements and air monitoring would be conducted to ensure nearby residential and worker safety in accordance with a site-specific health and safety plan.

The results from the previous environmental investigations indicate the material containing lead at a concentration greater than the rSRL of 400 mg/kg is either residual unbeneficiated tungsten ore or tailings. Mine ore and tailings are exempt from being classified as a RCRA hazardous waste per 40 CFR 261.4. This regulation, specifically the Bevill Exclusion to RCRA, excludes mine and beneficiation wastes and 20 specific types of mineral processing wastes from hazardous waste regulations (EPA, 2008). Milling of ore is considered a beneficiation of mine material. The unbeneficiated tungsten ore and tailings observed at the former ore mill site are not considered a hazardous waste and can be managed at the property as a waste. Managing the mining wastes on the property will be a more cost effective, timely, and sustainable means of managing the materials.

Prior to the placement of the consolidated excavated materials in the former building foundations, a geotechnical analysis of soil and slope stability would be necessary. Geotechnical samples would be submitted to a materials laboratory to evaluate the specific soil strength properties. Sample testing results would be used to develop cap and slope stability design measures.

Demolition of the building foundations may be necessary to prepare the area for placement of the soil cap and asphalt or concrete surface. Any materials generated during foundation demolition would be placed with the consolidated excavation materials. The excavated material would be stacked above the former building foundations to an elevation corresponding to the grade for the proposed park. In addition to the area of the former building foundations, consolidated excavation materials would be placed in depressions within the existing topography. A more detailed topographic aerial survey, to a resolution of 0.5 foot, would be obtained in the acreage within the building foundations to determine an accurate volume available for the consolidated materials to be contained and capped as part of Alternative 3b.

A demarcation layer would be placed between the consolidated excavation material and the surface cap. The surface cap would consist of clean soil fill imported and placed to a thickness of approximately two (2) feet over the demarcation layer. This would provide a barrier between ground surface and the ore material, preventing exposure by human receptors. The former mill building foundation area would be paved with asphalt or concrete to provide a protective barrier and to prevent infiltration of storm water into the ore material. The face of the north slope would also be capped with an impervious surface (i.e. sprayed concrete, shotcrete, grouted riprap) to prevent erosion and release of the consolidated materials. The soil surface (areas not covered by asphalt or concrete) could be restored with short-rooted native vegetation in conjunction with the park design.

Alternative 3b would also require the implementation of engineering controls and LUCs. The installation of a demarcation layer, the clean fill, and the concrete/asphalt surface and slope cap all are engineering controls that would be utilized to prevent human exposure to consolidated materials. In addition, a stormwater design plan would prevent erosion of the cap and prevent infiltration of storm water into consolidated materials. A LUC would need to be established to limit human exposure by restricting activity, use, and access to the property for day use recreational activities. In addition, a DEUR would need to be applied for and placed on the deed to the property. The DEUR (approved and granted by ADEQ) prevents any potential future residential development under the ownership of COT or any future property owner that would pose unacceptable exposure to the impacted soil.

In accordance with the engineering control plan and the DEUR requirements, Alternative 3b would also require inspection, monitoring and maintenance of the site to ensure that the direct contact with impacted materials to human receptors is prevented. The impervious surface and side slope cap should be inspected for signs of cracking, differential settlement, exposed impacted material and erosion. An annual report would be prepared and submitted to ADEQ documenting the inspection and maintenance, documenting compliance with the DEUR conditions. ADEQ reserves the right to inspect and take enforcement action if the conditions of the DEUR are not adequately maintained. The DEUR (and associated inspection and maintenance program) remains in effect until the COT or other future property owner demonstrates that the DEUR can be released (i.e., there is no longer potential for human receptor exposure to impacted soils).

Alternative 3b would meet the site-specific RAOs by reducing the risk of direct contact with impacted materials for human receptors. In addition, Alternative 3b would reduce infiltration of precipitation and the potential to leach to groundwater through the impervious (asphalt or concrete) surface.

10.4 Alternative 4: Excavate, Stabilize, and Transport Off-Site for Disposal

Alternative 4 is the excavation of material at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The excavated materials would be consolidated and stabilized in an on-site treatment area using a phosphate amendment for lead. Remaining building foundations would be demolished and incorporated into the excavation materials. All materials demolished and excavated/stabilized would be transported off-site to a licensed solid waste disposal facility.

Soil with a lead concentration greater than the ADEQ rSRL of 400 mg/kg would be excavated. Excavation would occur to depths ranging from one (1) to five (5) feet bgs, based on soil sample results generated from the environmental investigations summarized above in Section 6. The area of excavation is depicted in Figure 9. Remaining building foundations would be demolished and incorporated into the excavation material. Confirmation soil samples would be collected from the walls of the excavation and analyzed for total lead to verify materials remaining below the excavation are less than the lead rSRL of 400 mg/kg. Approximately 7,500 cubic yards of material would be excavated for off-site disposal. All excavation activities and soil handling would be conducted using appropriate BMPs with an approved site-specific SWPPP to prevent and/or minimize the discharge of pollutants under the AZPDES CGP. In addition, all fugitive dust would be controlled per Pima County dust permit requirements and air monitoring would be conducted to ensure nearby residential and worker safety in accordance with a site-specific health and safety plan.

Based on Toxicity Characteristic Leaching Procedure (TCLP) testing conducted during 2006, soil samples exceeded lead and cadmium regulatory levels that would be considered hazardous if the material were a waste and not considered part of the Bevill Exclusion under RCRA (Kleinfelder, 2006).

Excavated materials would be treated on-site using a phosphate stabilization amendment to reduce the leachable metals concentrations to a level below the threshold for hazardous waste for off-site disposal at a Subtitle D licensed landfill. Physical stabilization amendments encapsulate the lead particles and excavated materials, reducing metal solubility and promoting the precipitation of metal ions and the formation of relatively insoluble mineral species. The addition of phosphorous to lead contaminated soils has been shown to greatly reduce the bioavailability of lead in soils (Hettiarachchi and Pierzynski, 2002). Stabilization of the excavated materials would not reduce the constituent mass. The excavated materials and phosphate-based amendment would be mixed using a pug-mill or equivalent mixing mechanism. A treatability study would be performed to evaluate the amount of stabilization agent required to

reduce the concentration of leachable lead in the excavated materials, before full-scale implementation. The results of the treatability study would provide the optimal waste material-amendment mix ratio to stabilize leachable constituent levels below an appropriate regulatory level. After determining the optimal waste material-amendment mix ratio, stabilization would be implemented on a full scale.

Stabilized materials would be tested for leachable metals using TCLP procedures before disposal of the excavated materials. The stabilization process is anticipated to yield TCLP concentrations below the waste thresholds of concern for arsenic, cadmium, and lead. Results below waste thresholds of concern would enable the mixed excavation and demolition waste (i.e. construction waste) to be disposed of at a Subtitle D licensed landfill.

Clean fill would be imported, placed and compacted in accordance with the final grading plan. The soil surface could be restored with short-rooted native vegetation in conjunction with the park design.

Alternative 4 would not require the implementation of engineering controls and LUCs. In addition, Alternative 4 would not require a DEUR or inspections following the remediation because the constituent mass would be removed from the site. Alternative 4 will meet the site-specific RAOs by eliminating the on-site risk of direct contact with impacted materials for human receptors. The constituent mass within the soil would be removed from the site, resulting in a higher degree of long-term reliability. However, Alternative 4 is a less desirable option because it would be more expensive from increased fuel usage, heavy truck traffic, additional dust and noise generation, and overall neighborhood inconvenience.

11.0 EVALUATION OF REMEDIAL ALTERNATIVES

In this section, criteria described below are used to qualitatively evaluate the remedial alternatives developed in Section 10.

11.1 Protectiveness

Protectiveness considers the present and future public health, safety, and welfare, and the environment. Protectiveness is assessed in this report with respect to reducing or eliminating exposure to contaminated soil, either through contaminant mass reduction, or the use of engineering controls.

11.2 Remedy Selection Balancing Factors

The selected remedial alternative must balance the five remedy selection factors. These factors are described below.

Effectiveness - In general, effectiveness assesses the remedial action alternative's ability to achieve the desired level of protection as quickly as possible. Effectiveness measures the performance of the alternative up to the time when the RAOs are achieved and remedy implementation is complete. Whether the alternative can maintain these objectives over the long-term is assessed by the balancing factor of long-term reliability.

Long-Term Reliability - A remedy's long-term reliability is determined by the reliability of treatment technologies to achieve and maintain the protectiveness of the remedy, and if using engineering or institutional controls, on their reliability to manage residual risks. Long-term reliability is also influenced by uncertainties associated with potential long-term risk management.

Implementability - A remedy's implementability is evaluated on the basis of whether it is easy or difficult to implement depending on practical, technical, or legal difficulties that may be associated with conditions at the property and construction, including scheduling delays. Implementability also depends upon the ability to measure the remedy's effectiveness and its consistency with regulatory requirements, including applicable regulations.

Implementation Risk - Implementation risk evaluates the risks posed by the remedy during implementation (including construction and operation), based on potential impacts to the community, workers, and the environment, and the effectiveness and reliability of protective or mitigation measures. Implementation risk also considers the time needed to implement the remedy.

Reasonableness of Cost - A remedy's reasonableness of cost is evaluated on the following: Net present value (NPV) of the entire cost of each alternative (capital, operation and maintenance [O&M], regulatory agency oversight, closure reporting, and system decommissioning).

- Degree to which the costs are proportionate to the benefits to human health and the environment created by risk reduction.
- Degree to which the costs are proportionate to the benefits created through restoration or protection of groundwater beneficial use.
- The degree of sensitivity and uncertainty of the costs.

To provide a basis for comparing alternatives on the degree to which their costs are proportionate to their benefits (cost effectiveness), the cost per cubic yard of soil removed/remedied was estimated. Detailed cost descriptions for each alternative are presented in Appendix B. The costs include obtaining and complying with applicable permits, subcontractor activities, lab analyses, health and safety monitoring, geotechnical evaluations and subsequent annual monitoring and maintenance costs. The cost estimates do not include overall project management, oversight, and landscape design, which may cost an additional 25-40%.

Table 3 summarizes the comparative costs and balancing factor scores for each alternative. Each balancing factor was given a relative score between 1 and 5 (1 = worst to 5 = best). The following sections describe the balancing factors and relative scores and totals.

11.3 Alternative 1: No Action

(Overall Score: 18 out of 30)

Protectiveness

Alternative 1 does not achieve the protectiveness requirements, and the RAOs are not satisfied.

Effectiveness

Alternative 1 is not effective at reducing or managing risk. The magnitude of residual risk is not acceptable. The assessment of this alternative by this balancing factor should be adequate for eliminating this option from further consideration.

Long-Term Reliability

Alternative 1 does not achieve long-term reliability.

Implementability

Alternative 1 is very easy to implement.

Implementation Risk

No risk would be incurred during implementation of Alternative 1.

Reasonableness of Cost

No costs would be incurred in implementing the No Action alternative

11.4 Alternative 2: Engineering and Land Use Controls

(Overall Score: 19 out of 30)

Protectiveness

Alternative 2 satisfies the RAOs. Protectiveness is only partially achieved by reducing the physical accessibility to the area of concern with engineering controls (i.e., fence, appropriate permanent BMPs to prevent erosion down the slope, and dust monitoring) and placing deed restrictions on the property.

Effectiveness

Alternative 2 has a low effectiveness rating. Chain link fencing would minimize human exposure to the impacted material. Fencing would not prevent all human receptors (trespassers) from encountering the impacted material. Sediment and erosion control best management practices would prevent erosion down slope into Anklam Wash, but dust control may be a long-term issue during windy days.

Long-Term Reliability

The long-term reliability of engineering controls at the property is low. Fencing would not be easily incorporated into future development as a park and will not prevent all human receptors (trespassers) from encountering the impacted materials.

Implementability

Alternative 2 has a high degree of implementability. New fencing would be required, but is readily available, and easily installed. Additional permitting would be required to establish deed restrictions on the property.

Implementation Risk

There is little risk associated with chain link and silt fence installation. Therefore, the implementation risk for Alternative 2 is low.

Reasonableness of Cost

The total cost includes the acquisition of a deed restriction for the property and the usage of engineering controls (i.e., fence, silt fences to prevent erosion down the slope, and dust monitoring). The total cost also includes long-term monitoring of slope erosion and dust control. The cost of Alternative 2 is low.

The total projected NPV cost for Alternative 2 is \$153,000.

11.5 Alternative 3a: Excavate, Bury On-Site, and Engineered Cap

(Overall Score: 21 out of 30)

Protectiveness

Alternative 3a satisfies the RAOs established for the property. Protectiveness is achieved by eliminating the exposure pathway installing an engineered cap over the buried impacted materials.

Effectiveness

Construction of an engineered surface cap would be highly effective; the surface cap would prevent human exposure to contaminated soil. Impacted material below the cap would remain at concentrations exceeding ADEQ rSRLs, and would be a potential risk to construction and excavation workers if it was necessary to modify the capped area

Long-Term Reliability

The long-term reliability of an engineered cap in mitigating risk to human receptors associated with soil contamination is high assuming a routine inspection and appropriate maintenance of the cap integrity is in place.

Implementability

Alternative 3a has a moderate degree of implementability, as long as there is adequate planning before beginning the work.

Implementation Risk

The risk of implementing Alternative 3a is moderate. Dust must be controlled to protect nearby receptors (i.e., construction workers) during excavation and surface cap construction, but dust control measures are readily implementable. The risk associated with the exposure could be mitigated with the use of reasonable health and safety programs, proper personal protection equipment (PPE), and dust control measures. All workers would require proper HAZWOPER certification. Dust control and off-site tracking of soil on vehicle tires could be managed by wetting the soil as it is disturbed and by using a vehicle wheel-washing structure.

Reasonableness of Cost

The estimated NPV cost for Alternative 3a includes materials, equipment, replacing the soil with clean fill, and labor required for placing a cap. The costs assume that proper materials and equipment are locally available. The contaminant mass is not reduced within the existing soil, however, the cost for placing the cap is relatively moderate and combined with institutional controls would meet the RAOs. Therefore, the overall cost reasonableness is considered to be moderate.

The total projected NPV cost to implement Alternative 3a is \$766,000.

11.6 Alternative 3b: Excavate, Consolidate, and Cap

(Overall Score: 21 out of 30)

Protectiveness

Alternative 3b satisfies the RAOs established for the property. Protectiveness is achieved by eliminating the exposure pathway and consolidating the contaminant mass in the former ore mill site.

Effectiveness

Construction of a surface cap would be effective; the surface cap would prevent human exposure to contaminated soil. Consolidated material below the cap would remain at concentrations exceeding ADEQ rSRLs, and would be a potential risk to construction and excavation workers if it was necessary to modify the capped area.

Long-Term Reliability

The long-term reliability of a soil cap with an impervious surface in mitigating risk to human receptors associated with soil contamination is high assuming a routine inspection and appropriate maintenance of the cap integrity is in place.

Implementability

Alternative 3b has a moderate degree of implementability, as long as there is adequate planning before beginning the work.

Implementation Risk

The risk of implementing Alternative 3b is moderate. Dust must be controlled to protect nearby receptors (i.e., construction workers) during excavation and surface cap construction, but dust control measures are readily implementable. The risk associated with the exposure could be mitigated with the use of reasonable health and safety programs, proper personal protection equipment (PPE), and dust control measures. All workers would require proper HAZWOPER certification. Dust control and off-site tracking of soil on vehicle tires could be managed by wetting the soil as it is disturbed and by using a vehicle wheel-washing structure.

Reasonableness of Cost

The estimated NPV cost for Alternative 3b includes materials, equipment, replacing the soil with clean fill, and labor required for placing a cap. The costs assume that proper materials and equipment are locally available. The contaminant mass is not reduced within the existing soil, however, the cost for placing the cap is relatively moderate and combined with institutional controls would meet the RAOs. Therefore the overall cost reasonableness is considered to be moderate.

The total projected NPV cost to implement Alternative 3b is \$880,000.

11.7 Alternative 4: Excavate, Stabilize, and Transport Off-Site for Disposal

(Overall Score: 20 out of 30)

Protectiveness

Alternative 4 satisfies the RAOs. Protectiveness is achieved by contaminant removal from the property and treatment of impacted soil for disposal at a permitted landfill.

Effectiveness

Excavation and off-site disposal of excavated materials eliminates the risk of hazardous substances to human receptors. Removal of the impacted soil also reduces the potential for constituent leaching on-site. A treatability study is required to determine the amount amendment required to successfully treat the excavated material prior to its disposal as a solid waste.

Long-Term Reliability

The long-term reliability of Alternative 4 is considered to be very high as contaminant mass would be eliminated through transport off-site.

Implementability

Alternative 4 would be difficult to implement. Contaminated soil would have to be handled multiple times to complete stabilization. Calibration of the stabilization mix design may be difficult. Significant coordination will be required to stage soil for treatment, complete the treatment on-site, and transport the stabilized soil over public roads to the nearest Subtitle D landfill. Service providers and equipment for soil excavation, clean excavation fill, and transport to the landfill are readily available locally. Transport of the material across federal and state roadways to the landfill is regulated and the transportation service providers must adhere to state and federal requirements.

Implementation Risk

The risk of implementing Alternative 4 is high. Soil and stabilization agent dust must be controlled during implementation of Alternative 4; otherwise, nearby receptors may be exposed to contaminants during remedy implementation.

Additional implementation risks may result from the soil stabilization technology. There may be greater risks associated with inhalation of dust from the impacted soils and the stabilization agent. The risks for worker exposure through direct contact with the soil may be increased because the impacted material is handled multiple times during the remedy implementation. The risk remedy associated with the exposure could be mitigated with the use of reasonable health and safety programs, proper PPE, and dust control measures. All workers would require proper HAZWOPER certification. Dust control and off-site tracking of soil on vehicle tires could be managed by wetting soil as it is disturbed, and by using a vehicle wheel-washing structure. There is a low-level risk of spilling the impacted soil material during transport between the property and the landfill, which could possibly cause direct contact risks to human receptors in the area of the spill.

Reasonableness of Cost

The total cost includes the completion of a treatability study, on-site excavation and soil stabilization treatment, transport and disposal at a certified landfill, excavation backfilling with clean imported material, and the associated labor. The final mix ratio necessary to stabilize the metals in soil to concentrations below the appropriate cleanup levels are not currently known. The stabilization would provide a reduction in the leaching potential within the landfill. The overall cost for Alternative 4 is considered to be very high.

The total projected NPV cost for Alternative 4 is \$1,845,000.

12.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were compared with the ranking assigned to each alternative, using the five balancing factors of effectiveness, long-term reliability, implementability, implementation risk, and reasonableness of cost that were described in the above sections. The final semi-quantitative ranking values are presented in Table 3. The following provides the comparative analysis between all the alternatives, based on the five balancing factors.

12.1 Protectiveness

Alternative 1 is not protective. Alternative 2 is minimally protective because physical accessibility is only partially reduced at the site with a fence. Alternatives 3a and 3b are highly protective by eliminating the exposure pathway with a surface cap. Alternative 4 is very highly protective because the impacted soil is removed from the property and treated prior to disposal at a permitted landfill.

12.2 Effectiveness

Alternative 1 is not effective. Alternative 2 has a low effectiveness because it would not prevent all human receptors from encountering the impacted materials. Alternatives 3a and 3b have a high effectiveness rating because the direct contact risk would be removed, but no contaminant mass reduction would occur. Alternative 4 has a very high effectiveness because contaminant mass is removed from the site, eliminating residual risk.

12.3 Long-Term Reliability

Alternative 1 has a very low long-term reliability. Alternative 2 has a low reliability because it would not effectively prevent human receptors from encountering the impacted materials. Alternatives 3a and 3b have a high effective long-term reliability provided routine checks and maintenance are performed on the cap to maintain the cap integrity. Alternative 4 has a very high long-term reliability due to elimination of contaminant mass.

12.4 Implementability

Alternative 1 includes no implementation tasks. Alternative 2 requires minimal effort to implement. Alternatives 3a and 3b would require moderate effort to implement, including: planning; engineering design; on-site earthwork; and environmental, health and safety monitoring. Alternative 4 would be the most difficult to implement due the large amount of planning and coordination required to excavate, treat, transport, and dispose of all the impacted soil at the site. In general, equipment and services for all alternatives are readily available.

12.5 Implementation Risk

Alternative 1 does not have implementation risk because there are no implementation tasks. Alternative 2 has a low implementation risk because fencing installation is not a risk laden activity. Alternatives 3a and 3b have moderate implementation risk because it involves earthwork on-site. Alternative 4 has a high implementation risk, generally associated with more soil handling and treatment, and soil transportation.

12.6 Reasonableness of Cost

The cost effectiveness of each alternative was evaluated, as described in Section 12, by considering the cost per cubic yard of soil treated for Alternatives 1 through 4 (summarized in Table 3). The costs are rough order of magnitude (ROM) estimates and subject to change, based on uncertain factors, such as: when approval is granted for commencing the remedial work, the results of the site-specific treatability study, and the exact extent of impacted soils. The cost of fuel and construction activities is expected to continue rising each year.

Alternative	ROM Cost Estimate
1 - No Action	\$0
2 - Engineering and Land Use Controls	\$153,000
3a - Excavate, Bury On-Site, and Engineered Cap	\$766,000
3b - Excavate, Consolidate, and Cap	\$880,000
4 - Excavate, Stabilize, and Transport Off-Site for Disposal	\$1,845,000

13.0 SELECTION OF PREFERRED ALTERNATIVE

Although Alternatives 3a and 3b have the same overall scores, Alternative 3a is the recommended remedial action alternative for the property because it is protective, has a sufficient degree of effectiveness and long-term reliability, is implementable, and is moderately cost effective (cost per cubic yard remediated) in comparison to the other alternatives. Alternative 3a consists of excavation of material on the north slope of the former ore mill structure and the area south of the former ore mill structure exceeding the 400 mg/kg rSRL for lead. The above existing grade building foundations would be demolished. The excavated materials and demolished concrete would be placed in an excavated pit on the east side of the former ore mill structure. A 2.5-foot engineered soil cap would be installed over the remaining contamination footprint and the pit, using material from an off-site source. The borrow pit material would be used to backfill the flat area on the south end and the north slope and the surrounding topography would be modified to create 1 - 2 percent graded side slopes from the capped area.

14.0 REFERENCES

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15.0 LIMITATIONS

This report was prepared exclusively for the COT by AMEC. The quality of information, conclusions, and estimates contained herein are consistent with the level of effort involved in AMEC services and based on i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and quantifications set forth in this report. This ABCA is intended to be used by the COT for the Former Ore Mill Site (Pima County, Arizona) only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's own risk.

Estimates of construction costs or other costs related to the COT's project budget, if any, prepared by AMEC, are estimates only. It should be recognized that AMEC has no control over the cost of labor, materials, equipment, competitive bidding, market or negotiated conditions, unforeseen conditions, or over the contractor's method of determining bid prices. AMEC does not and cannot represent that bids or negotiated prices will not vary from cost estimates or from the COT's project budget.

The findings contained herein are relevant to the dates of the AMEC site visit and should not be relied upon to represent conditions at later dates. In the event that changes in the nature, usage, or layout of the property or nearby properties are made, the conclusions and recommendations in this report may not be valid. If additional information becomes available, it should be provided to AMEC so the original conclusions and recommendations can be modified as necessary.

TABLES

Table 1: Potential Applicable Regulations

Requirement			Type of ARAR			Not Applicable	Applicable	Relevant & Appropriate	Rationale and Comment	General Procedures for Compliance
Jurisdiction	Description	Citation	Chemical – Specific	Location-Specific	Action-Specific					
EPA	RCRA Land Disposal Restrictions	40 CFR 268	X		X		X		Land disposal restriction requirements. Sets treatment standards for RCRA hazardous wastes.	Alternatives 2 and 3 would be exempt from these regulations, per 40 CFR 261.4 under the Bevill Exclusion. TCLP concentrations must be satisfied prior to disposal as non-hazardous waste to Subtitle D landfill.
EPA	Safe Drinking Water Act	40 CFR 141	X			X			Establishes legally enforceable drinking water maximum contaminant levels for certain chemicals in public drinking water supplies. There are no public water supplies impacted by the contamination at the site.	Regulations are relevant and appropriate, but no specific procedures are necessary for the remediation operations at this site.
OSHA	Occupational Safety and Health Administration (OSHA) regulations	29 CFR Parts 1910, 1200	X		X		X		Defines health and safety training and monitoring requirements for on-site workers. Also, contains permissible exposure limits that need to be complied with during remediation activities.	Develop and implement site-specific health and safety plan, controls, and personal protective equipment. Implement air monitoring during all on-site work.
EPA, USACE	Permits to Discharge Dredged or Fill Material	CWA, Section 404		X	X		X		Permits and regulates the discharge of dredged or fill material into waters of the United States.	Comply with the conditions and controls outlined in by permit issued for the work.
EPA	National Pollutant Discharge Elimination System (NPDES) – Stormwater Discharges	40 CFR 122			X		X		Regulates storm water discharges into waters of the United States from sites with greater than 1 acre of soil disturbance.	Implement the practices and controls outlined by the site-specific Storm Water Pollution Prevention Plan.
EPA	National Emissions Standards for Hazardous Air Pollutants (NESHAPs)	CAA, Section 112, Part 61	X		X		X		Regulates release of asbestos during the demolition of asbestos-containing materials (concrete).	Sample and analyze concrete mill foundation for asbestos. An asbestos remediation contractor would need to properly remove the concrete if asbestos is detected.
ADEQ	Remedial Action Requirements	AAC, Title 18, Chap. 7, Appendix A.	X				X		Establishes standards and procedures to be followed for site cleanups. Defines remediation levels for residential and non-residential properties.	Reduce the COC concentrations to below the rSRLs.
ADEQ	Hazardous Waste Management	AAC R18-8-201 through R18-8-280	X		X		X		Regulates generation, transportation, treatment, storage, and disposal of hazardous waste.	Similar to compliance with RCRA Land Disposal Restrictions (above)
ADEQ	Arizona Solid Waste Management Regulations	ARS 49-701 through 49-881	X		X		X		Regulates non-hazardous solid waste. Defines specifications for clean fill.	Properly dispose of non-hazardous waste at the nearest landfill. Verify source of clean backfill.
ADEQ	Groundwater Protection Levels (GPLs)	A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality, September 1996	X					X	Guideline for soil concentration limits that are protective of groundwater quality.	Confirm that the soil concentrations do not exceed the concentrations protective of groundwater quality, per screening method.
PDEQ	Air Quality Requirements	Pima County Code Title 17, Air Quality			X		X		Regulates the generation of fugitive dust from land clearing activities.	Control fugitive dust emissions during all on-site activities.
City of Tucson	Traffic Controls				X			X	Necessary if using public roadways or right of ways.	Develop and comply with a traffic control plan.



City of Tucson
Former Ore Mill
Analysis of Brownfield Cleanup Alternatives
AMEC Job No. 08-114-03013
December 2008

Table 2
Assembled Alternatives - Assumptions and Unknowns
Former Ore Mill Site
City of Tucson

Alternative Description	Design Assumptions	Unknowns	Overall	
			Advantages	Disadvantages
<u>Alternative 1</u> No Action	No action would be performed at the site under Alternative 1. The impacted soils would be left in place without any additional remedy. A deed restriction would be filed on the property.	Potential for third party liability. Final future site use.	Lowest cost.	Does not meet RAOs for future development or provide any additional reduction of existing risks at the site.
<u>Alternative 2</u> Engineering and Land Use Controls	Implement engineering controls and LUCs to manage materials at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The existing fence would be left around the 2.1 acre portion of the property containing waste and/or minimizing the footprint of the waste area and then replacing the fencing. A deed restriction would be filed on the property.	Potential for third party liability. Final future site use.	Low cost and easily implementable.	Relative to the other alternatives, high level of maintenance and monitoring required for the life of the property.
<u>Alternative 3a</u> Excavate, Bury On-Site and Engineered Cap	Excavate material on the face of the slope north of the former ore mill structure and the area south of the former ore mill structure exceeding the 400 mg/kg rSRL for lead. The above existing grade building foundations would be demolished. The excavated materials and demolished concrete would be placed in an excavated pit on the east side of the former ore mill structure. A 2.5 foot engineered soil cap would be installed over the remaining contamination footprint and the pit, using material from an off-site source. The borrow pit material would be used to backfill the flat area on the south end and the north slope and the surrounding topography would be modified to create 1 to 2% graded side slopes from the capped area. A deed restriction would be filed on the property.	Final future site use and final park design.	Avoids disposal costs. Minimizes direct exposure pathway and provides protection for COCs leaching to groundwater at the site (moreso than Alternative 2). Reduces the amount of truck traffic and disturbance to the neighborhood.	Does not reduce or remove on-site constituent mass.
<u>Alternative 3b</u> Excavate, Consolidate, and Cap	Excavate material at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The excavated materials would be consolidated and placed in the former building foundations and other existing depressions nearby. The consolidated area and excavated slope would be capped with soil and an impervious (i.e. concrete, asphalt) material. Demolition may be necessary to prepare the area for grading and the eventual soil and asphalt or concrete cap. A deed restriction would be filed on the property.	Final future site use and final park design.	Avoids disposal costs. Minimizes direct exposure pathway and provides protection for COCs leaching to groundwater at the site. Reduces the amount of truck traffic and disturbance to the neighborhood.	Does not reduce or remove on-site constituent mass.
<u>Alternative 4</u> Excavate, Stabilize, and Transport Off-Site for Disposal	Excavate material at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The excavated materials would be consolidated and stabilized in an on-site treatment area using a phosphate amendment for lead. Remaining building foundations would be demolished and incorporated into the excavation materials. All materials demolished and excavated/stabilized would be transported off-site to a licensed solid waste disposal facility. No deed restriction would need to be filed on the property.	Effectiveness of the soil stabilization using phosphate amendment prior to disposal. A treatability study is necessary. Potential for third party liability.	Eliminates the risk of direct exposures and COCs leaching to groundwater at the site.	Highest cost. Increased truck traffic and disturbance to neighborhood.

Notes

mg/kg: milligrams per kilogram
rSRL: residential Soil Remediation Level
LUCs: Land Use Controls
TCLP: Toxicity Characteristic Leaching Procedure
COT: City of Tucson

General Assumptions

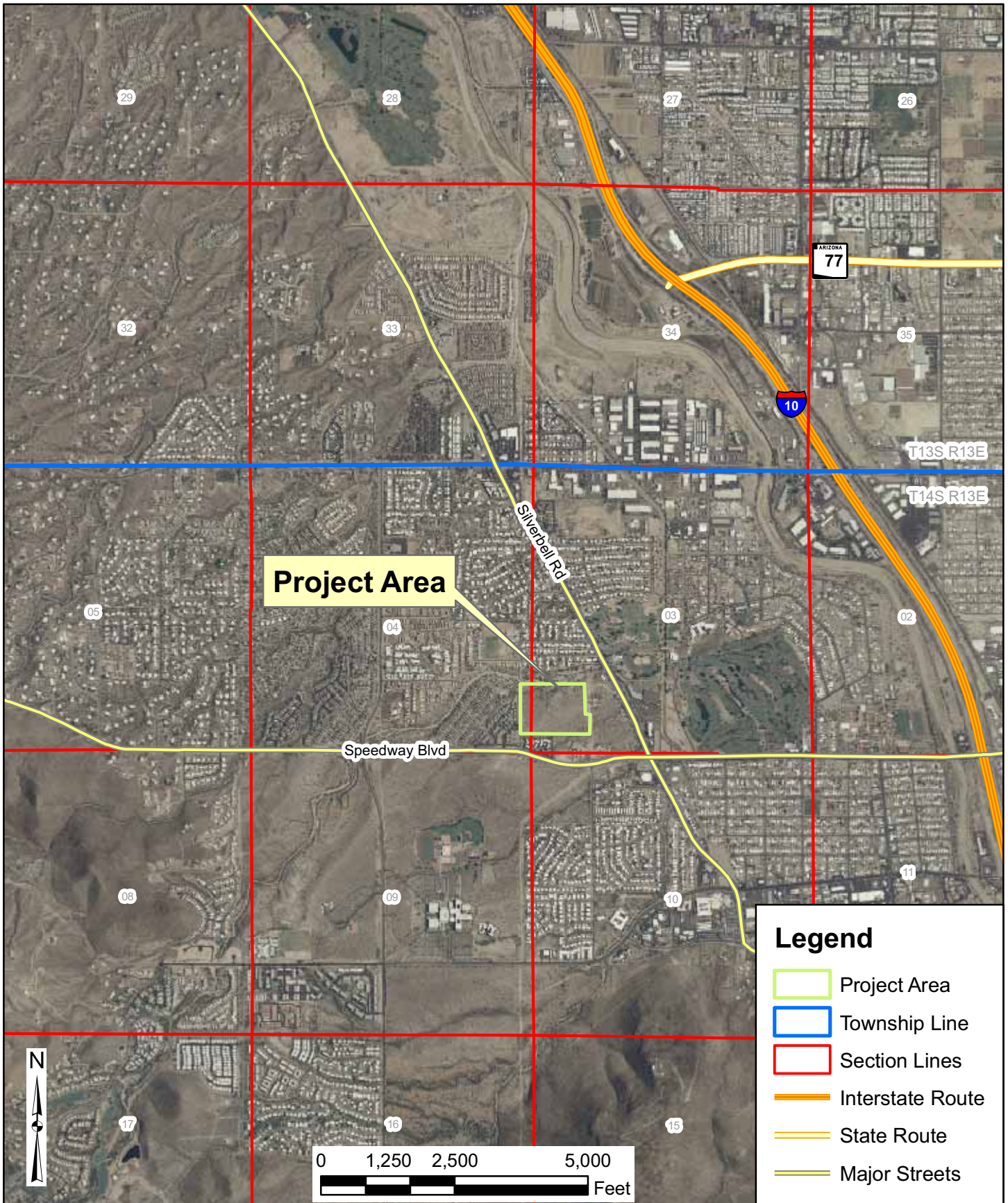
- Storm water controls will be implemented
- Concentration contours for the site are based on the property topographic survey.
- Future land use will include construction of natural resources COT park.
- Worker health and safety will be monitored, and a health and safety plan will be adopted for the site and communicated to site construction workers during construction.
- Constituents of concern include arsenic, cadmium, and lead. Lead is the driving COC for remediation.
- All final soil caps require annual inspection and minimal repair every 5 years.
- No additional contaminant sources will be encountered during the implementation of remedial action at the Site.
- Soil that meets TCLP requirements is permitted at Subtitle D landfill.



Table 3
Alternatives Final Screen
Former Ore Mill Site
City of Tucson

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Engineering and Land Use Controls	Alternative 3a Excavate, Bury On-Site and Engineered Cap	Alternative 3b Excavate, Consolidate, and Cap	Alternative 4 Excavate, Stabilize, and Transport Off-Site for Disposal
Protectiveness 5 = very high protectiveness	1 Very Low	2 Low	4 High	4 High	5 Very High
Effectiveness 5 = very high effectiveness	1 Very Low	2 Low	4 High	4 High	5 Very High
<i>Residual Risk</i>	High	Moderate	Low	Low	None
<i>Management of Residual Risk</i>	No	No	Yes	Yes	Yes
<i>Ability of Treatment Technologies to Meet Treatment Objectives</i>	Low	Moderate	Moderate	Moderate	High
<i>Time to Implement to Achieve RAOs</i>	N/A	1 month	2 months	2 months	3 months
<i>Monitoring Period</i>	N/A	Life of Ownership	Life of Ownership (minimal)	Life of Ownership (minimal)	None
Long-Term Reliability 5 = very high reliability	1 Very Low	2 Low	4 High	4 High	5 Very High
<i>Reliability of Treatment Technologies</i>	Very Low	Low	Moderate	Moderate	Very High
<i>Reliability of Engineering or Institutional Controls</i>	None	Low	Moderate	Moderate	Very High
<i>Nature, Degree, and Certainties or Uncertainties of Any Necessary Long-Term Management</i>	Risks associated with remaining COCs	Risks associated with remaining COCs	Risks from direct contact and infiltration of COCs are minimized, but still remain on-site. Long-term monitoring of the cap is necessary.	Risks from direct contact and infiltration of COCs are minimized, but still remain on-site. Long-term monitoring of the cap is necessary.	Risks from direct contact and infiltration of COCs are eliminated from the site. Long-term monitoring of the cap is not necessary (for COCs).
Implementability 5 = very easy to implement	5 Very Easy	5 Very Easy	3 Moderate	3 Moderate	2 Hard
<i>Difficulties and Unknowns Associated with Implementation</i>	None	Many	Few	Few	Some
<i>Ability to Monitor Effectiveness of Remedy</i>	N/A	Moderate	Easy	Easy	Easy
<i>Consistency with State, Federal, and Local Requirements</i>	Low	High	High	High	High
<i>Involvement of Other Agencies or Governmental Bodies</i>	Low	Moderate	Low	Low	Low
<i>Availability of Equipment, Specialists, and Services</i>	N/A	Moderate	High	High	High
Implementation Risk 5 = very low risk	5 Very Low	4 Low	3 Moderate	3 Moderate	2 High
Reasonableness of Cost 5=very low cost	5 Very Low	4 Low - \$/CY	3 Moderate - \$/CY	3 Moderate- \$/CY	1 Very High- \$/CY
<i>Estimate of Cost</i>	\$0	\$153,000	\$766,000	\$880,000	\$1,845,000
<i>Uncertainty of Costs</i>	None	Low	Low	Low	Moderate (Total amount of phosphate amendment needed is unknown until the treatability study is conducted)
Total Overall Score	18 Alternative 1	19 Alternative 2	21 Alternative 3a	21 Alternative 3b	20 Alternative 4

FIGURES



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 DATE: 07/22/2008
 SCALE: 1" = 2500'
 DATUM: NAD 83
 PROJ: UTM Zone 12

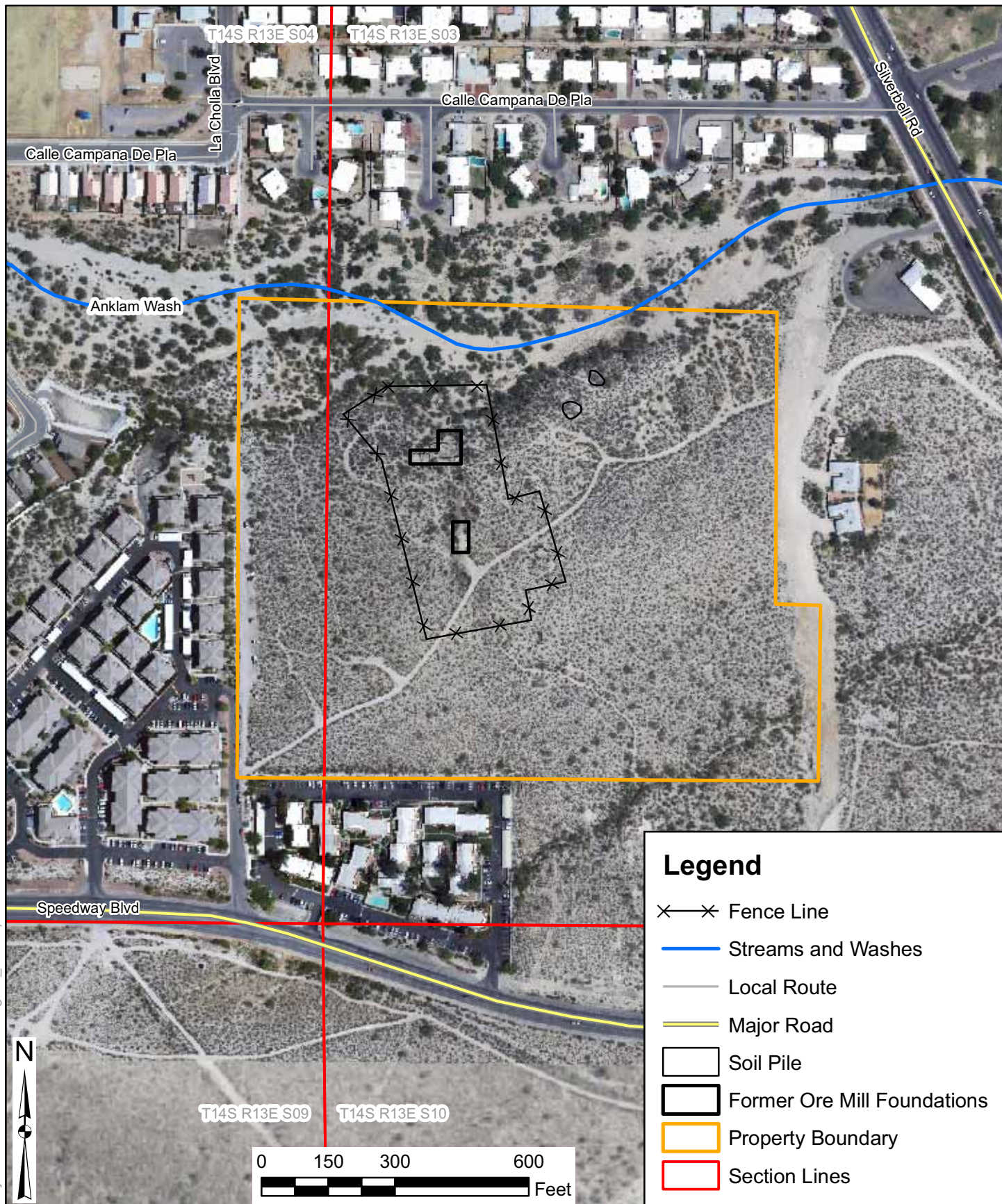
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City of Tucson Former Ore Mill

Project Area Map

FIGURE: 1





Legend

- ✕—✕ Fence Line
- Streams and Washes
- Local Route
- Major Road
- Soil Pile
- Former Ore Mill Foundations
- Property Boundary
- Section Lines

JOB NO: 08-114-03013
 DATE: 06/26/2008
 SCALE: 1" = 300'
 DATUM: NAD 83
 PROJ: UTM Zone 12

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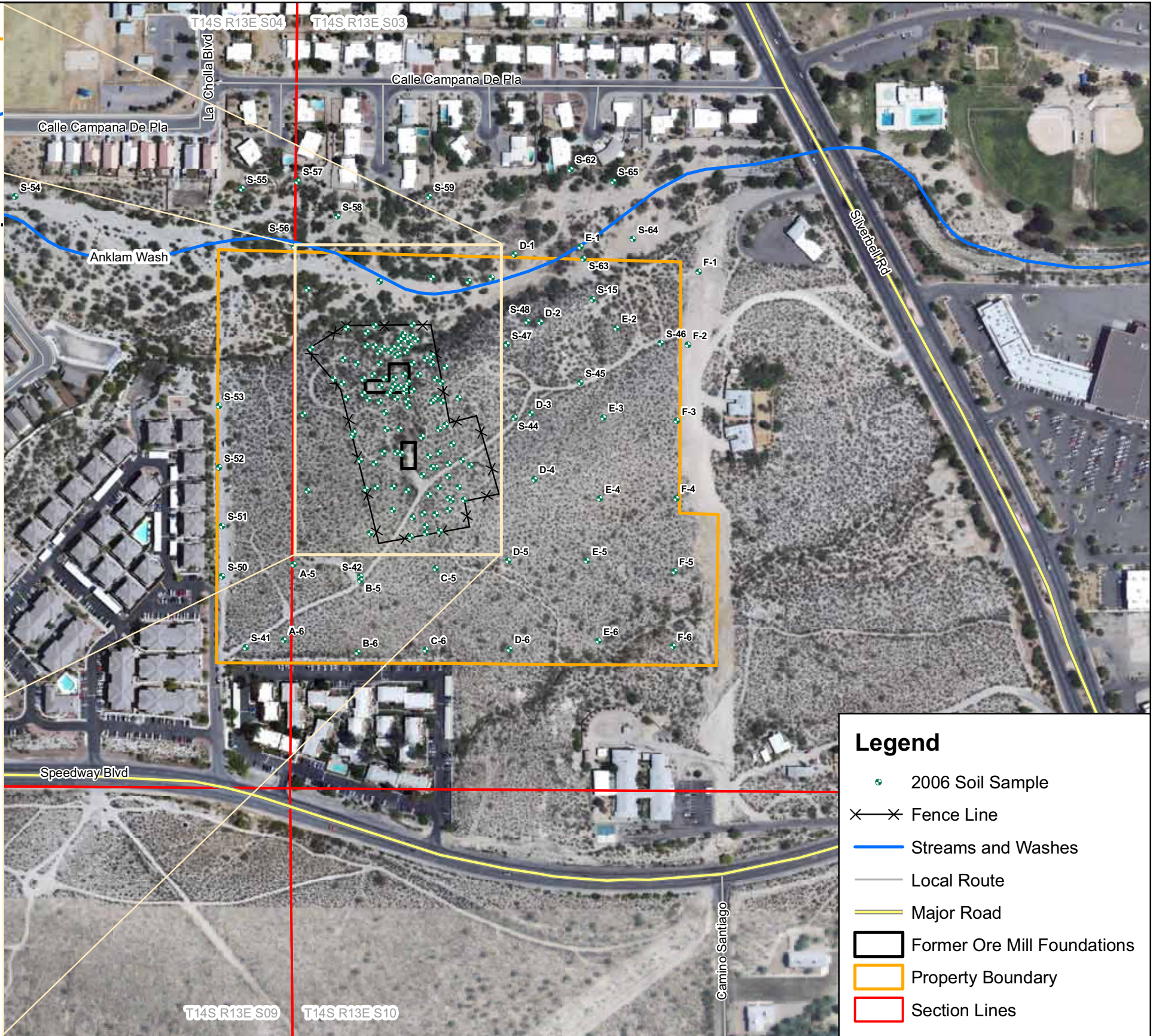
City of Tucson Former Ore Mill









Site Map

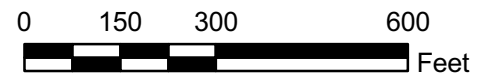
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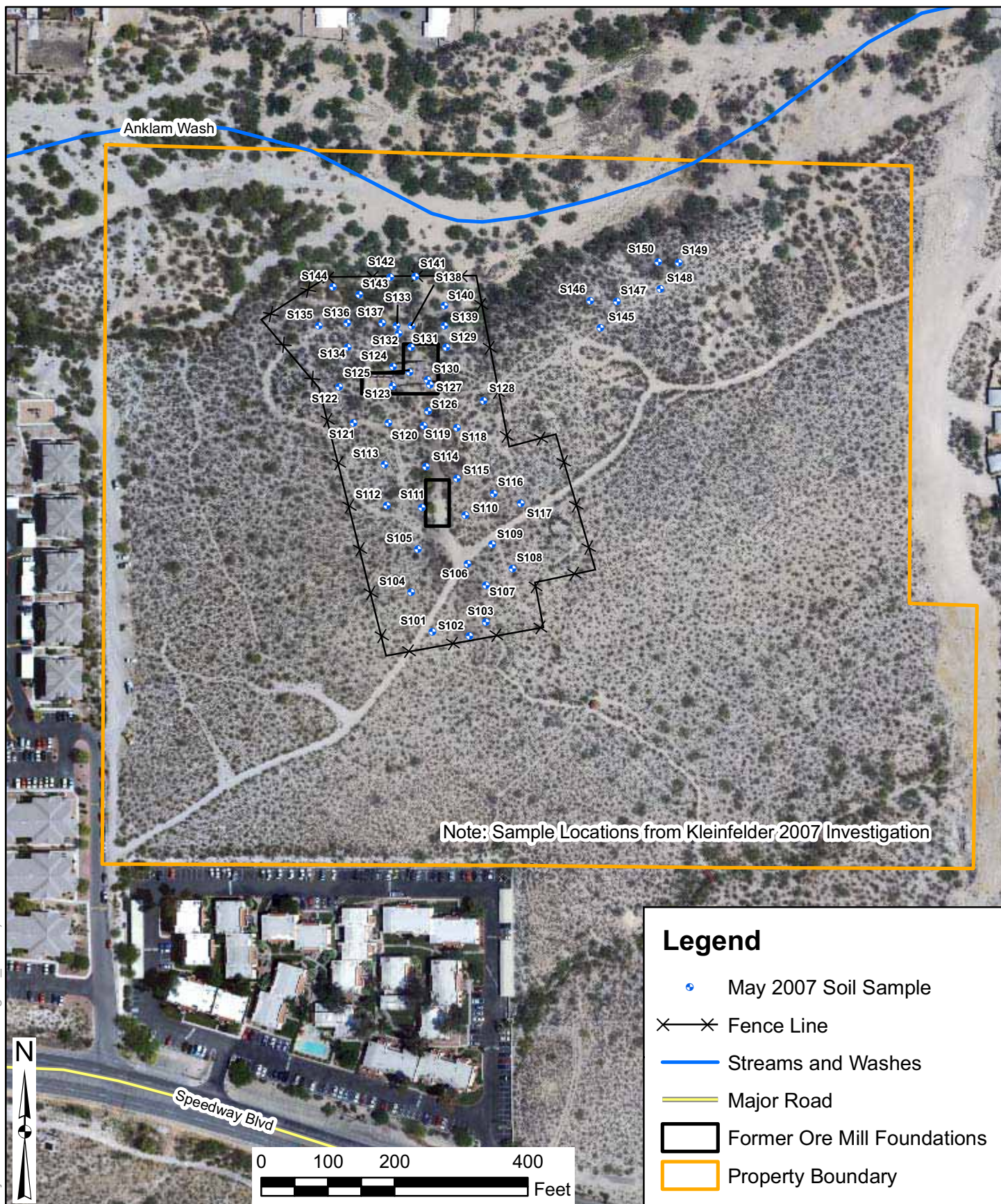


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-  2006 Soil Sample
-  Fence Line
-  Streams and Washes
-  Local Route
-  Major Road
-  Former Ore Mill Foundations
-  Property Boundary
-  Section Lines





JOB NO: 08-114-03013
 DATE: 06/26/2008
 SCALE: 1" = 200'
 DATUM: NAD 83
 PROJ: UTM Zone 12

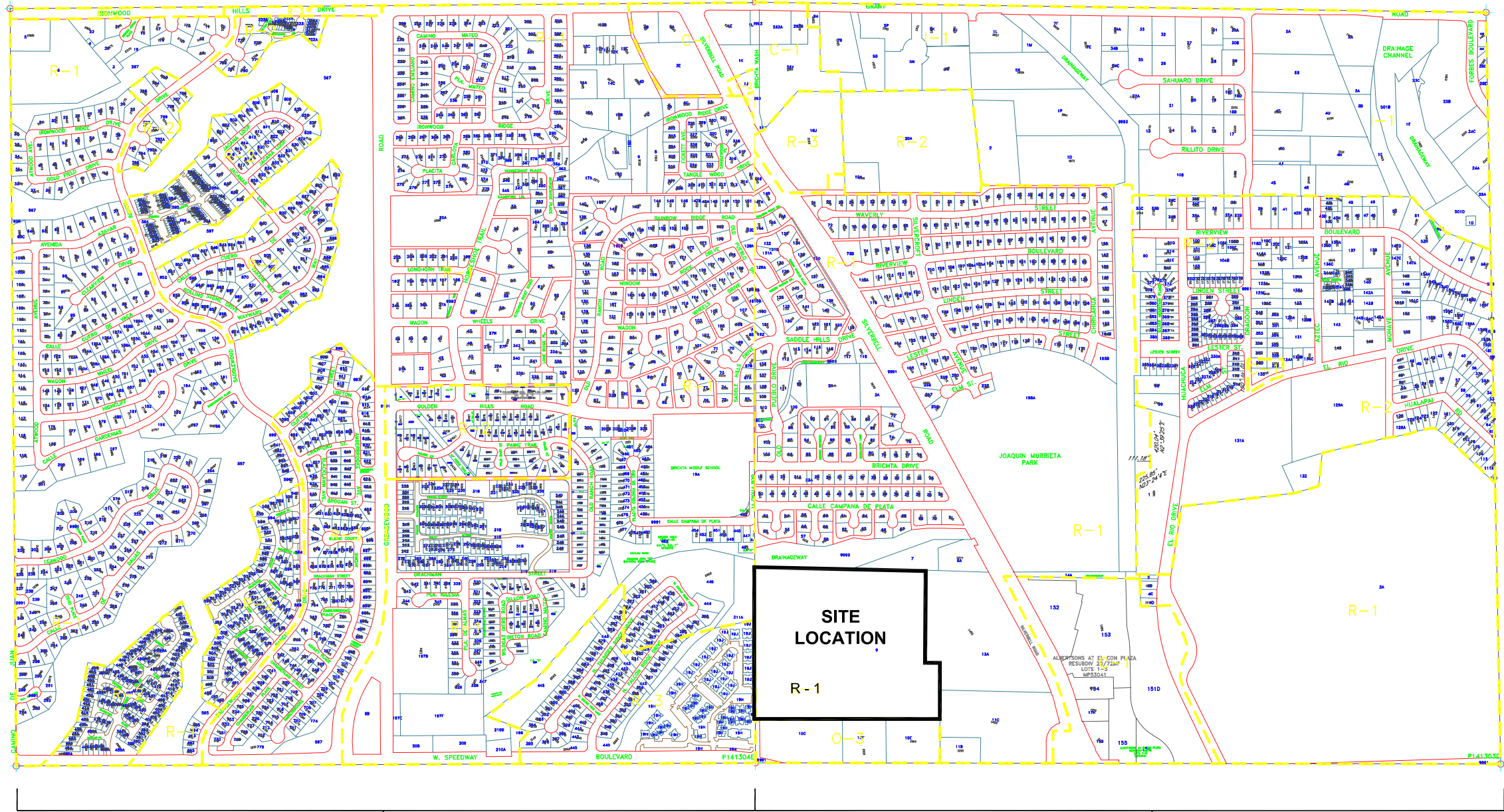
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City of Tucson Former Ore Mill

2007 Soil Sampling Locations
 Kleinfelder 2007 Investigation

FIGURE:
 4





SECTION 4

SECTION 3

CITY OF TUCSON
ZONING MAPS

ZONING MAPS SHOWING ZONING BY PARCEL WERE ESTABLISHED BY THE MAYOR AND COUNCIL ON APRIL 4, 1995 BY ORDINANCE 1475. MAPS ARE UPDATED PERIODICALLY TO REFLECT ANY ZONING CHANGES THAT ARE ADOPTED BY MAYOR AND COUNCIL. MAPS ARE ADDED TO THE SERIES AS NECESSARY TO SHOW CITY ZONING ON ANNEXED AREAS.

THE PROPERTY ADDRESSES SHOWN ON THE INDIVIDUAL PARCELS ARE PROVIDED FOR GENERAL INFORMATION PURPOSES ONLY. THE CITY DOES NOT WARRANT THE ACCURACY OF THE ADDRESSES SHOWN ON THESE MAPS AND DOES NOT ASSUME ANY LIABILITY FOR ANY HARM OR DAMAGE THAT MAY OCCUR AS A RESULT OF ANY ERRORS OR OMISSIONS ON THIS MAP.

CITY ZONE CODES

- R-1 RESIDENCE
- R-2 RESIDENCE (SINGLE/MULTIFAMILY)
- R-3 RESIDENCE (SINGLE/MULTIFAMILY)
- O-3 OFFICE
- C-1 BUSINESS (RESIDENTIAL/NONRESIDENTIAL)

T. 13 S., R. 12 E.	T. 13 S., R. 13 E.	T. 13 S., R. 14 E.
6	5	4
3	2	1
7	8	9
10	11	12
18	17	16
15	14	13
19	20	21
22	23	24
30	29	28
27	26	25
31	32	33
34	35	36
T. 14 S., R. 12 E.	T. 14 S., R. 13 E.	T. 14 S., R. 14 E.

0 125 250 FT.

SEC. 3, T. 14 S., R. 13 E.
Checked 4/14/05
SEC. 4, T. 14 S., R. 13 E.

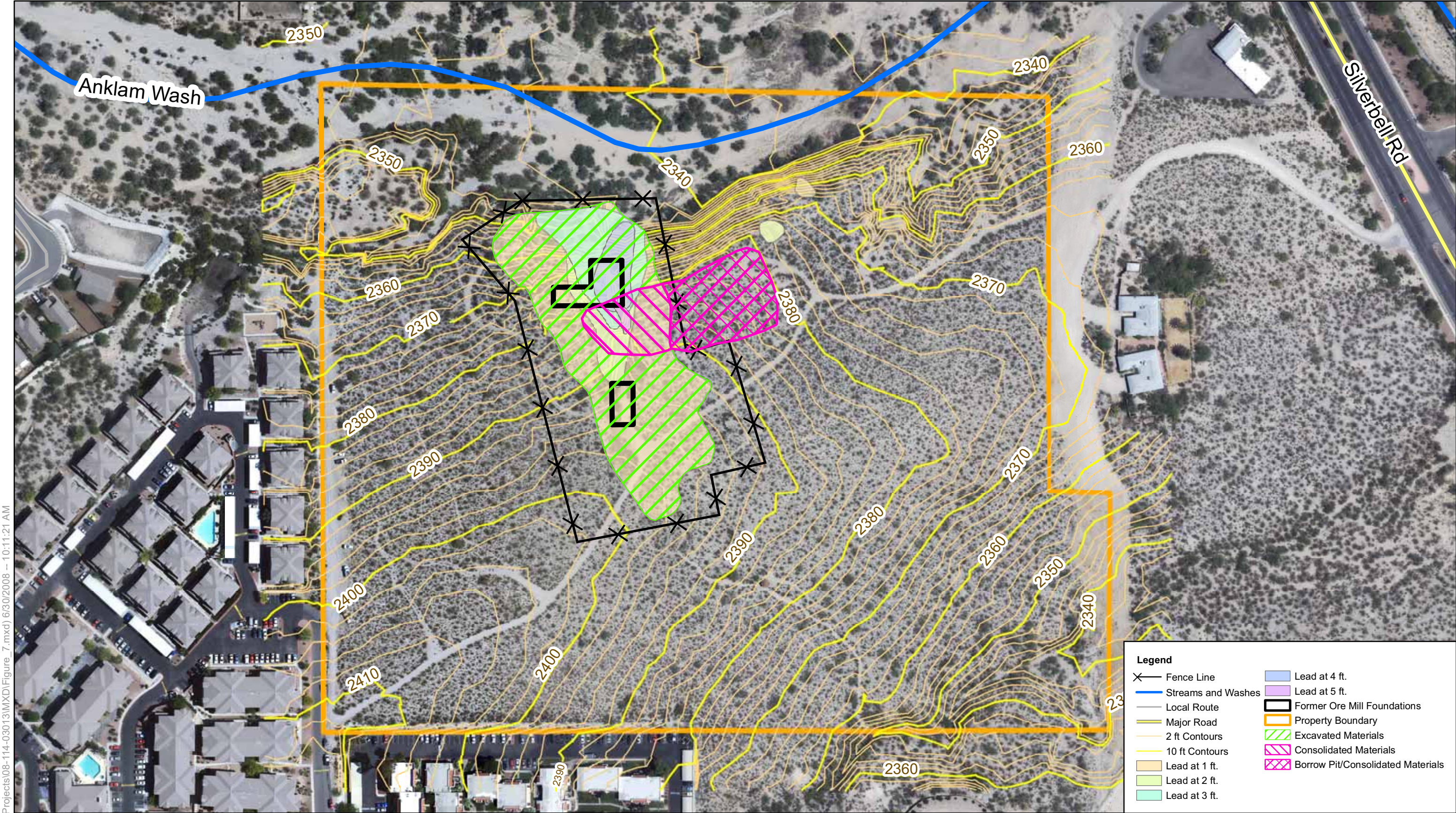
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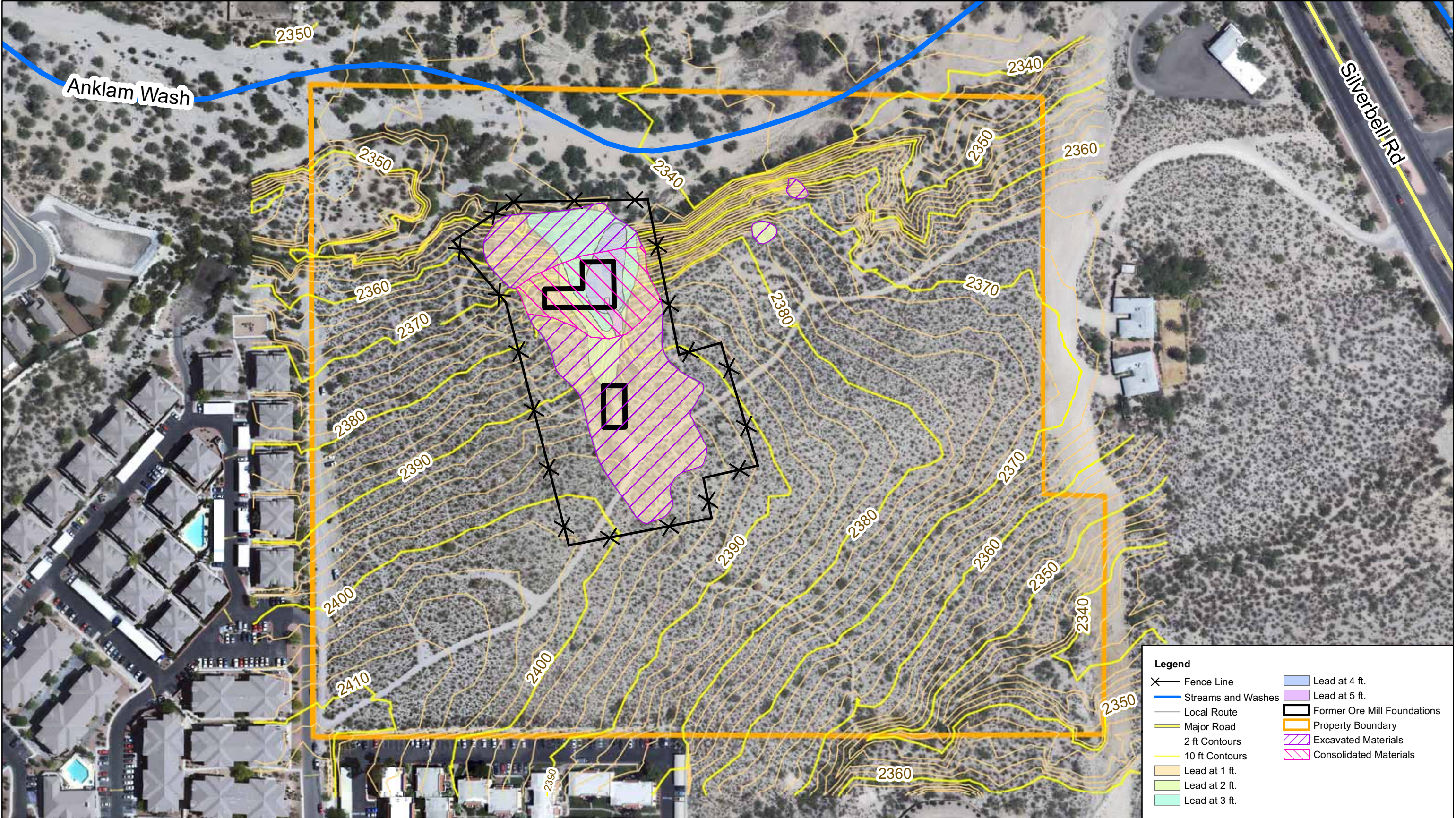
- Fence Line
- Streams and Washes
- Local Route
- Major Road
- 2 ft Contours
- 10 ft Contours
- Lead at 1 ft.
- Lead at 2 ft.
- Lead at 3 ft.
- Lead at 4 ft.
- Lead at 5 ft.
- Former Ore Mill Foundations
- Property Boundary

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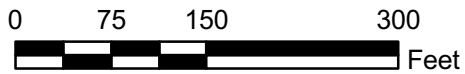
JOB NO: 08-114-03013 DATE: 06/26/2008 SCALE: 1" = 150' DATUM: NAD 83 PROJ: UTM Zone 12	<small>The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: 08-114-03013. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind as AMEC assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.</small>			City of Tucson Former Ore Mill		
				Remedial Alternative 3a	FIGURE: 7	

Map Document: (X:\Projects\08-114-03013\MXD\Figure_8.mxd) 6/30/2008 -- 10:11:21 AM



JOB NO: 08-114-03013
DATE: 06/26/2008
SCALE: 1" = 150'
DATUM: NAD 83
PROJ: UTM Zone 12

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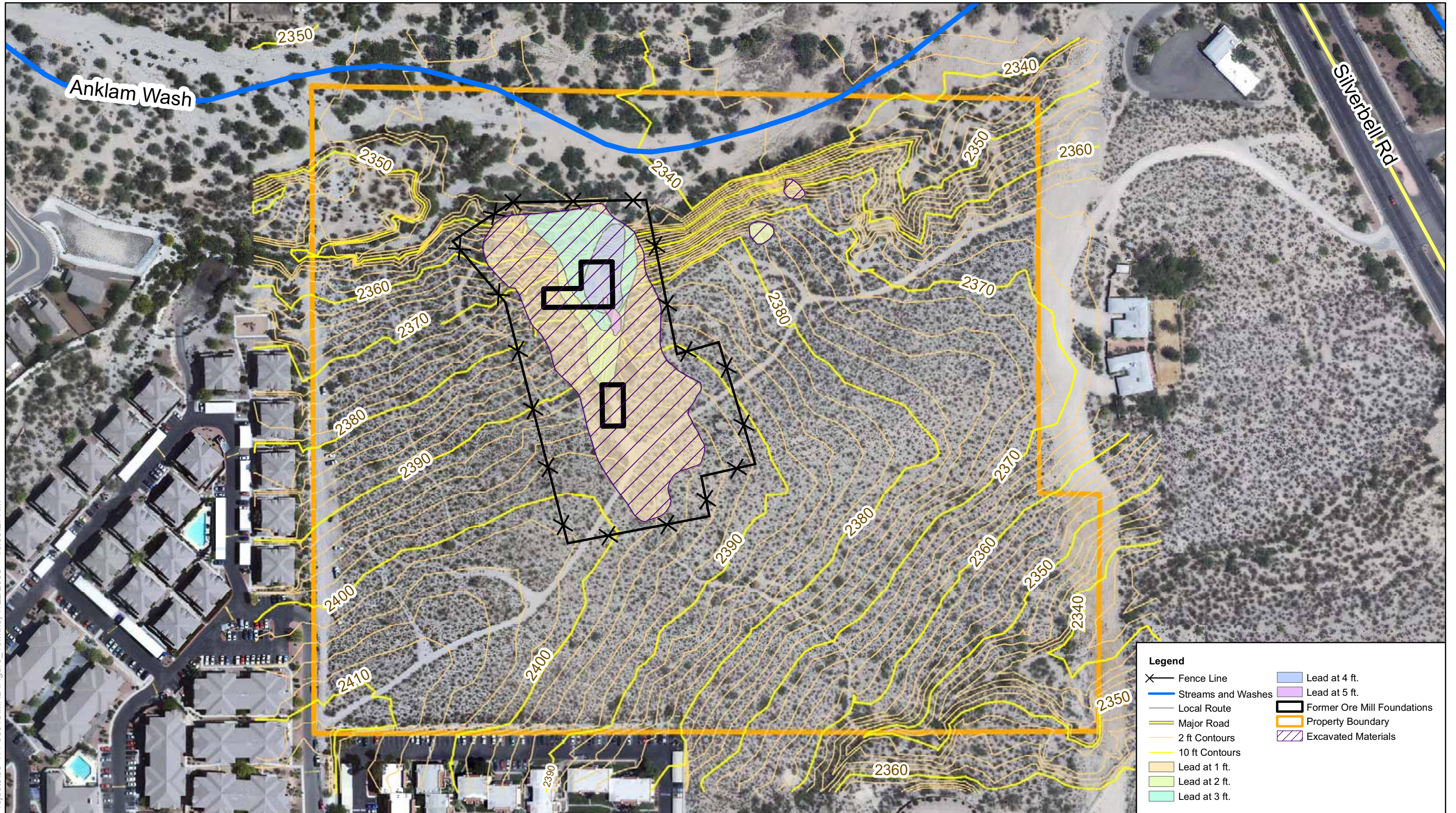
City of Tucson Former Ore Mill

Remedial Alternative3b

FIGURE:
8



Map Document: (X:\Projects\08-114-03013\MXD\Figure_10.mxd) 7/22/2008 -- 10:38:27 AM



JOB NO: 08-114-03013
DATE: 06/26/2008
SCALE: 1" = 150'
DATUM: NAD 83
PROJ: UTM Zone 12

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0 75 150 300
Feet

City of Tucson Former Ore Mill

Remedial Alternative 4

FIGURE:
9



APPENDIX A

SOIL SAMPLING RESULTS

5. ANALYTICAL RESULTS

5.1. Analytical Results

TABLE 1
Total Metals Concentrations, mg/Kg (ppm)
Former Ore Mill Site

Sample ID	Depth (ft. bgs)	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
S-1-0.5-1.0	0.5-1.0	41	94	19	5.3	6,600	<5.0	2.6	0.40
S-2-0.5-1.0	0.5-1.0	120	92	19	7.3	15,000	<5.0	4.1	0.24
S-3-0.5-1.0	0.5-1.0	56	130	7.3	2.9	1,900	<5.0	<2.5	0.25
S-4-0.5-1.0	0.5-1.0	130	76	43	17	28,000	<5.0	3.7	0.52
S-5-0.5-1.0	0.5-1.0	1,500	110	6.4	6.8	8,300	<5.0	48	4.0
S-6-0.5-1.0	0.5-1.0	64	86	10	20	6,100	<25	<12	0.14
S-7-0.5-1.0	0.5-1.0	37	80	4.4	13	6,200	<25	<12	0.19
S-8-0.5-0.8	0.5-0.8	63	100	6.7	25	6,000	<25	<12	0.34
S-9-0.5-1.0	0.5-1.0	91	160	21	42	13,000	48	16	0.71
S-10-0.5-1.0	0.5-1.0	65	110	14	20	7,900	<25	<12	0.43
S-11-0.5-1.0	0.5-1.0	53	150	3.8	12	2,100	<25	<12	<0.10
S-12-0.5-1.0	0.5-1.0	58	100	17	19	4,000	<25	<12	0.23
S-13-0.5-1.0	0.5-1.0	140	130	16	34	4,100	<25	<12	0.23
S-14-0.5-1.0	0.5-1.0	70	90	41	23	14,000	<25	<12	0.25
S-15-0.5-1.0	0.5-1.0	< 25	280	<2.5	11	<25	<25	<12	<0.10
S-16-0.5-1.0	0.5-1.0	37	260	4.5	34	1,900	68	<12	<0.10
S-17-0.5-1.0	0.5-1.0	< 25	120	6.6	11	160	<25	<12	<0.10
S-18-0.5-1.0	0.5-1.0	< 25	92	<2.5	11	160	<25	<12	<0.10
RSRL	---	10	5,300	38	2,100	400	380	380	6.7*
NRSRL	---	10	110,000	850	4,500	2,000	8,500	8,500	180*
TCLP Standards mg/L (ppm)									
TCLP 40CFR 261.24	---	5.0	100.0	1.0	5.0	5.0	1.0	5.0	0.2

mg/Kg (ppm) = milligrams per kilogram or parts per million

mg/L (ppm) = milligrams per liter or parts per million

ft. bgs = feet below ground surface

RSRL = Residential Soil Remediation Level

NRSRL = Non-residential Soil Remediation Level

Bold = Exceeds RSRL

* RSRL and NRSRL for elemental mercury

TABLE 1
Total RCRA Metals and Tungsten Concentrations
Arsenic, Cadmium, and Lead Concentrations by TCLP
Former Ore Mill Site
Date Sampled: August 31, 2006

Sample ID	Depth (ft. bgs)	Total Arsenic (mg/Kg)	TCLP Arsenic (mg/L)	Total Barium (mg/Kg)	Total Cadmium (mg/Kg)	TCLP Cadmium (mg/L)	Total Chromium (mg/Kg)	Total Lead (mg/Kg)	TCLP Lead (mg/L)	Total Selenium (mg/Kg)	Total Silver (mg/Kg)	Total Mercury (mg/Kg)	Total Tungsten (mg/Kg)
S-1-0.5-1.0	0.5-1.0	41	---	94	19	---	5.3	6,600	---	<5.0	2.6	0.40	680
S-2-0.5-1.0	0.5-1.0	120	---	92	19	---	7.3	15,000	---	<5.0	4.1	0.24	670
S-3-0.5-1.0	0.5-1.0	56	---	130	7.3	---	2.9	1,900	---	<5.0	<2.5	0.25	680
S-4-0.5-1.0	0.5-1.0	130	<0.50	76	43	1.2	17	28,000	36	<5.0	3.7	0.52	850
S-5-0.5-1.0	0.5-1.0	1,500	<0.50	110	6.4	<0.25	6.8	8,300	59	<5.0	48	4.0	<50
S-6-0.5-1.0	0.5-1.0	64	---	86	10	---	20	6,100	---	<25	<12	0.14	600
S-7-0.5-1.0	0.5-1.0	37	---	80	4.4	---	13	6,200	---	<25	<12	0.19	580
S-8-0.5-0.8	0.5-0.8	63	---	100	6.7	---	25	6,000	---	<25	<12	0.34	1,000
S-9-0.5-1.0	0.5-1.0	91	<0.50	160	21	<0.25	42	13,000	10	48	16	0.71	4,200
S-10-0.5-1.0	0.5-1.0	65	---	110	14	---	20	7,900	---	<25	<12	0.43	1,200
S-11-0.5-1.0	0.5-1.0	53	---	150	3.8	---	12	2,100	---	<25	<12	<0.10	1,100
S-12-0.5-1.0	0.5-1.0	58	---	100	17	---	19	4,000	---	<25	<12	0.23	2,100
S-13-0.5-1.0	0.5-1.0	140	<0.50	130	16	<0.25	34	4,100	3.4	<25	<12	0.23	640
S-14-0.5-1.0	0.5-1.0	70	<0.50	90	41	0.54	23	14,000	30	<25	<12	0.25	740
S-15-0.5-1.0	0.5-1.0	<25	---	280	<2.5	---	11	<25	---	<25	<12	<0.10	<50
S-16-0.5-1.0	0.5-1.0	37	---	260	4.5	---	34	1,900	---	68	<12	<0.10	6,100
S-17-0.5-1.0	0.5-1.0	<25	---	120	6.6	---	11	160	---	<25	<12	<0.10	480
S-18-0.5-1.0	0.5-1.0	<25	---	92	<2.5	---	11	160	---	<25	<12	<0.10	100
RSRL		10	-	5,300	38	-	2,100	400	-	380	380	6.7*	NE
NRSRL		10	-	110,000	850	-	4,500	2,000	-	8,500	8,500	180*	NE
TCLP		-	5.0	-	-	1.0	-	-	5.0	-	-	-	-

NOTES

mg/Kg (ppm) = milligrams per kilogram or parts per million
mg/L (ppm) = milligrams per liter or parts per million
ft. bgs = feet below ground surface
RSRL = Residential Soil Remediation Level
NRSRL = Non-residential Soil Remediation Level
TCLP = Toxicity Characteristic Leaching Procedure, 40 CFR 261.24 Standards
Bold = Exceeds RSRL
NE = Not Established
--- = Not Analyzed
* = RSRL and NRSRL for elemental mercury

TABLE 1
Total RCRA Metals and Tungsten Concentrations
Arsenic, Cadmium, and Lead Concentrations by TCLP
Former Ore Mill Site
Date Sampled: August 31, 2006 and September 21-22, 2006

Sample ID	Depth (ft. bgs)	Total Arsenic (mg/Kg)	TCLP Arsenic (mg/L)	Total Barium (mg/Kg)	Total Cadmium (mg/Kg)	TCLP Cadmium (mg/L)	Total Chromium (mg/Kg)	Total Lead (mg/Kg)	TCLP Lead (mg/L)	Total Selenium (mg/Kg)	Total Silver (mg/Kg)	Total Mercury (mg/Kg)	Total Tungsten (mg/Kg)
S-1-0.5-1.0	0.5-1.0	41	---	94	19	---	5.3	6,600	---	<5.0	2.6	0.40	680
S-2-0.5-1.0	0.5-1.0	120	---	92	19	---	7.3	15,000	---	<5.0	4.1	0.24	670
S-3-0.5-1.0	0.5-1.0	56	---	130	7.3	---	2.9	1,900	---	<5.0	<2.5	0.25	680
S-4-0.5-1.0	0.5-1.0	130	<0.50	76	43	1.2	17	28,000	36	<5.0	3.7	0.52	850
S-5-0.5-1.0	0.5-1.0	1,500	<0.50	110	6.4	<0.25	6.8	8,300	59	<5.0	48	4.0	<50
S-6-0.5-1.0	0.5-1.0	64	---	86	10	---	20	6,100	---	<25	<12	0.14	600
S-7-0.5-1.0	0.5-1.0	37	---	80	4.4	---	13	6,200	---	<25	<12	0.19	580
S-8-0.5-0.8	0.5-0.8	63	---	100	6.7	---	25	6,000	---	<25	<12	0.34	1,000
S-9-0.5-1.0	0.5-1.0	91	<0.50	160	21	<0.25	42	13,000	10	48	16	0.71	4,200
S-10-0.5-1.0	0.5-1.0	65	---	110	14	---	20	7,900	---	<25	<12	0.43	1,200
S-11-0.5-1.0	0.5-1.0	53	---	150	3.8	---	12	2,100	---	<25	<12	<0.10	1,100
S-12-0.5-1.0	0.5-1.0	58	---	100	17	---	19	4,000	---	<25	<12	0.23	2,100
S-13-0.5-1.0	0.5-1.0	140	<0.50	130	16	<0.25	34	4,100	3.4	<25	<12	0.23	640
S-14-0.5-1.0	0.5-1.0	70	<0.50	90	41	0.54	23	14,000	30	<25	<12	0.25	740
S-15-0.5-1.0	0.5-1.0	<25	---	280	<2.5	---	11	<25	---	<25	<12	<0.10	<50
S-16-0.5-1.0	0.5-1.0	37	---	260	4.5	---	34	1,900	---	68	<12	<0.10	6,100
S-17-0.5-1.0	0.5-1.0	<25	---	120	6.6	---	11	160	---	<25	<12	<0.10	480
S-18-0.5-1.0	0.5-1.0	<25	---	92	<2.5	---	11	160	---	<25	<12	<0.10	100
S-19	0-0.5	<5.0	---	82	<0.50	---	2.5	74	---	<5.0	<2.5	<0.10	180
S-20	0-0.5	<5.0	---	82	2.4	---	2.6	190	---	<5.0	<2.5	<0.10	340
S-21	0-0.5	<5.0	---	97	<0.50	---	2.4	36	---	<5.0	<2.5	<0.10	5.0
S-22	0-0.5	<5.0	---	120	0.95	---	2.7	260	---	<5.0	<2.5	<0.10	600
S-23	0-0.5	<5.0	---	150	<0.50	---	2.1	16	---	<5.0	<2.5	<0.10	<5.0
S-24	0-0.5	<5.0	---	63	<0.50	---	<2.0	12	---	<5.0	<2.5	<0.10	<5.0
S-25	0-0.5	<5.0	---	85	0.76	---	2.8	190	---	<5.0	<2.5	<0.10	86

TABLE 1
Total RCRA Metals and Tungsten Concentrations
Arsenic, Cadmium, and Lead Concentrations by TCLP
Former Ore Mill Site
Date Sampled: August 31, 2006 and September 21-22, 2006

Sample ID	Depth (ft. bgs)	Total Arsenic (mg/Kg)	TCLP Arsenic (mg/L)	Total Barium (mg/Kg)	Total Cadmium (mg/Kg)	TCLP Cadmium (mg/L)	Total Chromium (mg/Kg)	Total Lead (mg/Kg)	TCLP Lead (mg/L)	Total Selenium (mg/Kg)	Total Silver (mg/Kg)	Total Mercury (mg/Kg)	Total Tungsten (mg/Kg)
S-26	0-0.5	12	---	150	3.9	---	3.1	1600	---	<5.0	<2.5	<0.10	200
S-27	0-0.5	<5.0	---	78	0.50	---	3.1	110	---	<5.0	<2.5	<0.10	48
S-28	0-0.5	<5.0	---	93	1.1	---	3.3	120	---	<5.0	<2.5	<0.10	280
SD-1 (S-28)	0-0.5	<5.0	---	100	1.2	---	2.8	140	---	<5.0	<2.5	<0.10	320
S-29	0-0.5	<5.0	---	260	8.7	---	2.4	3800	---	<5.0	<2.5	0.20	400
S-30	0-0.5	150	---	110	6.7	---	2.6	2300	---	<5.0	8.0	0.23	430
S-31	0-0.5	120	---	82	9.0	---	<2.0	3200	---	<5.0	6.4	0.85	410
S-32	0-0.5	<5.0	---	70	0.79	---	<2.0	270	---	<5.0	<2.5	<0.10	18
S-33	0-0.5	<5.0	---	86	<0.50	---	<2.0	70	---	<5.0	<2.5	<0.10	6.2
S-34	0-0.5	56	---	150	2.6	---	2.7	620	---	<5.0	<2.5	0.12	140
S-35	0-0.5	<5.0	---	320	11	---	3.3	1100	---	<5.0	<2.5	0.14	680
S-36	0-0.5	32	---	86	12	---	4.5	4400	---	<5.0	<2.5	<0.10	640
S-37	0-0.5	<5.0	---	54	2.2	---	2.6	790	---	<5.0	<2.5	0.18	220
S-38	0-0.5	130	---	150	24	---	15	13000	---	<5.0	3.8	0.30	240
S-39	0-0.5	450	---	85	12	---	18	10000	---	<5.0	16	0.94	80
S-40	0-0.5	82	---	97	8.8	---	16	9900	---	<5.0	<2.5	<0.10	240
S-41	0-0.5	<5.0	---	99	<0.50	---	8.6	16	---	<5.0	<2.5	<0.10	<5.0
S-42	0-0.5	<5.0	---	87	0.81	---	5.6	45	---	<5.0	<2.5	<0.10	150
S-43	0-0.5	<5.0	---	88	<0.50	---	8.6	110	---	<5.0	<2.5	<0.10	<5.0
S-44	0-0.5	<5.0	---	120	<0.50	---	7.6	15	---	<5.0	<2.5	<0.10	<5.0
S-45	0-0.5	7.6	---	140	<0.50	---	7.6	15	---	7.1	<2.5	<0.10	<5.0
S-46	0-0.5	<5.0	---	96	<0.50	---	7.9	33	---	<5.0	<2.5	<0.10	<5.0
S-47	0-0.5	<5.0	---	1100	12	---	110	22000	---	<5.0	4.3	0.66	<5.0

TABLE 1
Total RCRA Metals and Tungsten Concentrations
Arsenic, Cadmium, and Lead Concentrations by TCLP
Former Ore Mill Site
Date Sampled: August 31, 2006 and September 21-22, 2006

Sample ID	Depth (ft. bgs)	Total Arsenic (mg/Kg)	TCLP Arsenic (mg/L)	Total Barium (mg/Kg)	Total Cadmium (mg/Kg)	TCLP Cadmium (mg/L)	Total Chromium (mg/Kg)	Total Lead (mg/Kg)	TCLP Lead (mg/L)	Total Selenium (mg/Kg)	Total Silver (mg/Kg)	Total Mercury (mg/Kg)	Total Tungsten (mg/Kg)
S-48	0-0.5	<5.0	---	680	6.2	---	52	1500	---	<5.0	<2.5	0.52	<5.0
S-49	0-0.5	<5.0	---	85	1.1	---	11	210	---	<5.0	<2.5	<0.10	21
S-50	0-0.5	6.0	---	170	<0.50	---	3.6	10	---	<5.0	<2.5	<0.10	<5.0
S-51	0-0.5	5.8	---	130	<0.50	---	3.8	9.8	---	<5.0	<2.5	<0.10	<5.0
S-52	0-0.5	11	---	210	<0.50	---	5.4	19	---	6.6	<2.5	<0.10	<5.0
S-53	0-0.5	6.2	---	220	<0.50	---	5.0	9.8	---	6.1	<2.5	<0.10	<5.0
S-54	0-0.5	<5.0	---	82	<0.50	---	<2.0	13	---	<5.0	<2.5	<0.10	<5.0
S-55	0-0.5	<5.0	---	110	<0.50	---	8.4	23	---	<5.0	<2.5	<0.10	<5.0
S-56	0-0.5	<5.0	---	74	<0.50	---	2.6	16	---	<5.0	<2.5	<0.10	<5.0
S-57	0-0.5	<5.0	---	59	<0.50	---	<2.0	11	---	<5.0	<2.5	<0.10	<5.0
S-58	0-0.5	<5.0	---	92	<0.50	---	<2.0	16	---	<5.0	<2.5	<0.10	<5.0
S-59	0-0.5	<5.0	---	86	<0.50	---	<2.0	19	---	<5.0	<2.5	<0.10	<5.0
S-60	0-0.5	<5.0	---	94	<0.50	---	<2.0	16	---	<5.0	<2.5	<0.10	<5.0
S-61	0-0.5	<5.0	---	100	<0.50	---	<2.0	21	---	<5.0	<2.5	<0.10	<5.0
S-62	0-0.5	<5.0	---	91	0.62	---	6.0	200	---	<5.0	<2.5	<0.10	<5.0
S-63	0-0.5	<5.0	---	82	<0.50	---	5.2	110	---	<5.0	<2.5	<0.10	<5.0
S-64	0-0.5	<5.0	---	54	<0.50	---	7.2	250	---	<5.0	<2.5	<0.10	<5.0
S-65	0-0.5	<5.0	---	74	<0.50	---	<2.0	25	---	<5.0	<2.5	<0.10	<5.0
S-66	0-0.5	<5.0	---	82	<0.50	---	<2.0	15	---	<5.0	<2.5	<0.10	<5.0
SD-2 (S-66)	0-0.5	<5.0	---	80	<0.50	---	<2.0	23	---	<5.0	<2.5	<0.10	<5.0
RSRL		10	-	5,300	38	-	2,100	400	-	380	380	6.7*	NE
NRSRL		10	-	110,000	850	-	4,500	2,000	-	8,500	8,500	180*	NE
TCLP		-	5.0	-	-	1.0	-	-	5.0	-	-	-	-

TABLE 1
Total RCRA Metals and Tungsten Concentrations
Arsenic, Cadmium, and Lead Concentrations by TCLP
Former Ore Mill Site
Date Sampled: August 31, 2006 and September 21-22, 2006

NOTES

mg/Kg (ppm)	= milligrams per kilogram or parts per million
mg/L (ppm)	= milligrams per liter or parts per million
ft. bgs	= feet below ground surface
RSRL	= Residential Soil Remediation Level
NRSRL	= Non-residential Soil Remediation Level
TCLP	= Toxicity Characteristic Leaching Procedure, 40 CFR 261.24 Standards
Bold	= Exceeds RSRL
NE	= Not Established
---	= Not Analyzed
S	= Surface sample
*	= RSRL and NRSRL for elemental mercury

TABLE 2
Arsenic, Cadmium, and Lead Concentrations by X-Ray Fluorescence (XRF)
Former Ore Mill Site
Grid Samples and Judgemental Samples

Sample ID (Lab Conf.)	Date of Survey	Total Arsenic (mg/Kg)	Total Cadmium (mg/Kg)	Total Lead (mg/Kg)
A-6	10/05/06	<16	<60	<20
B-6	10/05/06	<17	<67	<21
C-6	10/05/06	<12	<61	<15
D-6	10/05/06	<16	<63	<20
E-6	10/05/06	<15	<61	<18
F-6	10/05/06	<17	<63	<20
F-5	10/05/06	<16	<65	<21
E-5	10/05/06	<15	<58	<18
D-5	10/05/06	<15	<61	<19
C-5	10/05/06	<22	<63	77
B-5	10/05/06	<26	<69	80
A-5	10/05/06	<15	<59	<19
A-4	10/05/06	<19	<64	24
B-4	10/05/06	<37	<65	335
C-4	10/05/06	<96	<69	2225
D-4	10/05/06	<14	<63	<17
E-4	10/05/06	<18	<61	28
F-4	10/05/06	<13	<59	<15
F-3	10/05/06	<15	<59	<19
E-3	10/05/06	<15	<60	<19
D-3	10/05/06	<34	<62	300
C-3	10/05/06	<20	<61	54
B-3	10/05/06	<60	<68	871
A-3	10/05/06	<17	<59	28
A-2	10/05/06	<21	<61	61
B-2	10/05/06	<166	<68	7012
C-2	10/05/06	<27	<58	205
D-2	10/05/06	<21	<63	44
E-2	10/05/06	<13	<61	<17
F-2	10/05/06	<14	<64	<17
F-1	10/05/06	<15	<59	<18
E-1	10/05/06	<16	<59	22
D-1	10/05/06	<14	<63	<17
C-1	10/05/06	<14	<59	<17
B-1	10/05/06	<12	<56	<15
A-1	10/05/06	<14	<61	<17
JSa-40	10/05/06	<126	68	4049
JSa-41	10/05/06	1271	<67	5942
JSa-42	10/05/06	<117	<65	3811

TABLE 2
Arsenic, Cadmium, and Lead Concentrations by X-Ray Fluorescence (XRF)
Former Ore Mill Site
Grid Samples and Judgemental Samples

Sample ID (Lab Conf.)	Date of Survey	Total Arsenic (mg/Kg)	Total Cadmium (mg/Kg)	Total Lead (mg/Kg)
JSa-43	10/05/06	<15	<58	<18
JSa-44	10/05/06	<13	<59	<16
JSa-45	10/05/06	<137	<66	5009
JSa-46	10/05/06	<54	<60	861
JSa-47	10/05/06	29	<58	165
JSa-48	10/05/06	<18	<59	52
JS-2	10/10/06	<26	<61	122
JS-3	10/10/06	<75	<71	1268
JS-4	10/10/06	<58	<62	1070
JS-5	10/10/06	<81	<59	2243
JS-6	10/10/06	<68	<60	1448
JS-7	10/10/06	<77	<60	1912
JS-8	10/10/06	<140	<67	5392
JS-9	10/10/06	<116	<106	1532
JS-10	10/10/06	<46	<60	639
JS-11	10/10/06	<50	<61	711
JS-12	10/10/06	<25	<61	129
JS-13	10/10/06	<40	<59	499
JS-14	10/10/06	<25	<57	158
JS-15	10/10/06	<41	<63	436
JS-16	10/10/06	<28	<58	230
JS-17	10/10/06	<76	<60	1856
JS-18	10/10/06	<32	<59	260
JS-19	10/10/06	<29	<60	195
JS-20	10/10/06	<34	<63	265
JS-21	10/10/06	116	<60	2784
JS-22	10/10/06	<110	<167	3380
JS-23	10/10/06	<38	<57	459
JS-25	10/10/06	<12	<57	<14
JS-26	10/10/06	<30	<56	266
JS-27	10/10/06	<77	<66	1583
JS-28	10/10/06	<109	<62	3561
JS-29	10/10/06	235	95	9003
JS-30	10/10/06	<147	<68	5586
JS-31	10/10/06	219	122	4962
JS-32	10/10/06	<34	<57	349
JS-33	10/10/06	<25	<57	152
JS-34	10/10/06	<73	<63	1642
JS-35	10/10/06	<58	<60	1031
JS-36	10/10/06	<56	<61	908

TABLE 2
Arsenic, Cadmium, and Lead Concentrations by X-Ray Fluorescence (XRF)
Former Ore Mill Site
Grid Samples and Judgemental Samples

Sample ID (Lab Conf.)	Date of Survey	Total Arsenic (mg/Kg)	Total Cadmium (mg/Kg)	Total Lead (mg/Kg)
JS-37	10/10/06	90	<68	1559
JS-38	10/10/06	<13	<61	<16
JS-39	10/10/06	<24	<60	127
JS-40	10/10/06	<27	<60	176
JS-41	10/10/06	<121	<60	3905
JS-42	10/10/06	<30	<60	225
JS-43	10/10/06	<22	<61	61
JS-44	10/10/06	<23	<62	71
JS-45	10/10/06	<19	<63	43
JS-46	10/10/06	<152	<70	5509
JS-47	10/10/06	<44	<62	229
JS-48	10/10/06	<45	<60	575
JS-49	10/10/06	<153	<71	5766
JS-50	10/10/06	<82	<64	1918
RSRL		10	38	400
NRSL		10	850	2,000

NOTES

Only positive XRF Results are used for RSRL comparison.

mg/Kg (ppm) = milligrams per kilogram or parts per million
 RSRL = Residential Soil Remediation Level
 NRSL = Non-residential Soil Remediation Level
Bold = Exceeds RSRL
 A-6 = Grid sample
 JSa = Judgemental sample (for delineation)
 JS = Judgemental sample (for delineation)

TABLE 3
Grid Confirmation Samples for Arsenic, Cadmium, and Lead Concentrations
Former Ore Mill Site
Date Sampled: October 10, 2006

Grid Point	XRF Arsenic (mg/Kg)	Laboratory Arsenic (mg/Kg)	Ratio XRF/Lab	XRF Cadmium (mg/Kg)	Laboratory Cadmium (mg/Kg)	Ratio XRF/Lab	XRF Lead (mg/Kg)	Laboratory Lead (mg/Kg)	Ratio XRF/Lab
C-4	<96	<5.0	NA	<69	3.8	NA	2,225	2,000	1.11
C-3	<20	<5.0	NA	<61	<0.50	NA	54	100	0.54
D-3	<34	<5.0	NA	<62	<0.50	NA	300	110	2.7
E-4	<18	<5.0	NA	<61	<0.50	NA	28	32	0.87
D-6	<16	<5.0	NA	<63	<0.50	NA	<20	14	NA
A-6	<16	<5.0	NA	<60	<0.50	NA	<20	14	NA
A-3	<17	<5.0	NA	<59	<0.50	NA	38	34	1.11
B-2	<166	66	NA	<68	21	NA	7,012	9,000	0.77

NOTES

Values > 1 = indicate conservative XRF results.

Values < 1 = indicate non-conservative XRF results.

mg/Kg (ppm) = milligrams per kilogram or parts per million

NA = a ratio cannot be calculated because either the or both the XRF and laboratory samples had results less than the PQL.

Table 1

**Summary of XRF Measurements
Ore Mill Site, City of Tucson**

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)				Cadmium (Cd)				Lead (Pb)				Tungsten (W)			
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)
S101	00	GS	8-May-07	<LOD	15	<LOD	63	<LOD	237	7	580	16							
S101	05	0.5	9-May-07	<LOD	7	<LOD	61	<LOD	22	3	14	4							
S102	00	GS	8-May-07	126	19	<LOD	65	<LOD	3854	38	873	25							
S102	05	0.5	9-May-07	12	3	<LOD	59	<LOD	50	4	64	6							
S103	00	GS	8-May-07	<LOD	24	<LOD	64	<LOD	683	13	640	21							
S103	05	0.5	9-May-07	<LOD	5	<LOD	46	<LOD	22	3	12	3							
S104	00	GS	8-May-07	<LOD	13	<LOD	59	<LOD	205	6	268	11							
S104	05	0.5	9-May-07	<LOD	5	<LOD	46	<LOD	24	3	<LOD	8							
S105	00	GS	8-May-07	26	8	<LOD	62	<LOD	619	12	587	17							
S105	05	0.5	9-May-07	<LOD	10	<LOD	48	<LOD	170	5	102	6							
S105	10	1.0	9-May-07	<LOD	4	<LOD	46	<LOD	14	2	<LOD	6							
S106	00	GS	8-May-07	<LOD	45	<LOD	62	<LOD	2655	28	186	15							
S106	05	0.5	9-May-07	<LOD	4	<LOD	48	<LOD	16	3	<LOD	7							
S107	00	GS	8-May-07	<LOD	65	<LOD	69	<LOD	4654	46	170	23							
S107	05	0.5	9-May-07	<LOD	5	<LOD	46	<LOD	27	3	<LOD	7							
S108	00	GS	8-May-07	<LOD	37	<LOD	61	<LOD	1834	21	469	17							
S108	05	0.5	9-May-07	<LOD	5	<LOD	47	<LOD	20	3	<LOD	8							
S109	00	GS	8-May-07	<LOD	42	<LOD	63	<LOD	2239	25	199	16							
S109	05	0.5	9-May-07	<LOD	5	<LOD	46	<LOD	30	3	<LOD	8							
S110	00	GS	8-May-07	<LOD	19	<LOD	19	<LOD	507	10	41	7							
S110	05	0.5	9-May-07	<LOD	5	<LOD	46	<LOD	30	3	<LOD	8							
S111	00	GS	8-May-07	130	29	<LOD	72	<LOD	7604	70	379	30							
S111	05	0.5	9-May-07	<LOD	5	<LOD	48	<LOD	16	3	<LOD	7							
S112	00	GS	8-May-07	28	6	<LOD	62	<LOD	416	9	202	10							
S112	05	0.5	9-May-07	<LOD	4	<LOD	48	<LOD	13	2	<LOD	7							
S113	00	GS	8-May-07	30	8	<LOD	63	<LOD	755	13	46	9							
S113	05	0.5	10-May-07	<LOD	5	<LOD	47	<LOD	17	3	<LOD	8							
S113	10	1.0	10-May-07	<LOD	4	<LOD	46	<LOD	16	2	<LOD	6							

Table 1

**Summary of XRF Measurements
Ore Mill Site, City of Tucson**

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)				Cadmium (Cd)				Lead (Pb)				Tungsten (W)			
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)
S114	00	GS	8-May-07	456	33	87	24	10066	86	1174	34								
S114	05	0.5	10-May-07	<LOD	15	<LOD	48	397	8	913	17								
S114	10	1.0	10-May-07	<LOD	5	<LOD	47	38	3	34	4								
S115	00	GS	8-May-07	94	14	64	21	2201	25	171	14								
S115	05	0.5	10-May-07	19	3	<LOD	46	179	5	<LOD	9								
S115	10	1.0	10-May-07	<LOD	5	<LOD	46	24	3	<LOD	7								
S116	00	GS	8-May-07	<LOD	34	<LOD	63	1448	19	326	15								
S116	05	0.5	9-May-07	<LOD	5	<LOD	47	21	3	<LOD	8								
S117	00	GS	8-May-07	<LOD	26	<LOD	60	943	14	60	8								
S117	05	0.5	9-May-07	<LOD	6	<LOD	48	31	3	<LOD	8								
S118	00	GS	8-May-07	<LOD	24	69	19	829	13	412	13								
S118	05	0.5	10-May-07	<LOD	5	<LOD	46	22	3	<LOD	7								
S119	00	GS	8-May-07	80	13	65	21	2125	24	102	13								
S119	05	0.5	10-May-07	737	43	<LOD	79	12951	122	<LOD	130								
S119	10	1.0	10-May-07	204	50	<LOD	80	18355	166	<LOD	125								
S119	15	1.5	10-May-07	<LOD	16	<LOD	56	359	8	160	9								
S119	30	3.0	10-May-07	12	3	<LOD	57	57	4	<LOD	10								
S120	00	GS	8-May-07	<LOD	26	<LOD	61	907	14	137	10								
S120	05	0.5	10-May-07	<LOD	5	<LOD	47	25	3	<LOD	8								
S121	00	GS	8-May-07	<LOD	40	<LOD	61	2212	24	133	14								
S121	05	0.5	10-May-07	14	4	<LOD	46	221	6	21	4								
S121	10	10.0	10-May-07	<LOD	6	<LOD	46	36	3	<LOD	8								
S122	00	GS	8-May-07	<LOD	45	66	21	2656	28	456	17								
S122	05	0.5	10-May-07	<LOD	8	<LOD	47	102	4	188	8								
S123	00	GS	8-May-07	201	16	<LOD	67	2539	29	6773	71								
S123	05	0.5	9-May-07	15	3	<LOD	55	109	5	57	5								
S123	10	1.0	9-May-07	20	3	<LOD	55	111	5	66	7								
S123	15	1.5	9-May-07	16	3	<LOD	56	101	5	51	5								

Table 1

**Summary of XRF Measurements
Ore Mill Site, City of Tucson**

				Arsenic (As)		Cadmium (Cd)		Lead (Pb)		Tungsten (W)	
				RSRL 10 mg/Kg		RSRL 39 mg/Kg		RSRL 400 mg/Kg		RSRL None	
				NRSRL 10 mg/Kg		NRSRL 850 mg/Kg		NRSRL 800 mg/Kg		NRSRL None	
				GPL 290 mg/Kg		GPL 29 mg/Kg		GPL 290 mg/Kg		GPL - None	
				Site Specific GPL - Not Calculated		Site Specific GPL - 51 mg/Kg		Site Specific GPL - 923 mg/Kg		Site Specific GPL - Not Calculated	
				XRF Analysis		XRF Analysis		XRF Analysis		XRF Analysis	
Location ID	Depth ID	Sample Depth (feet)	Date	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)
S123	20	2.0	9-May-07	10	3	<LOD	56	56	4	28	4
S123	25	2.5	9-May-07	9	3	<LOD	56	56	4	23	4
S124	00	GS	8-May-07	613	44	<LOD	77	14892	132	3233	54
S124	05	0.5	9-May-07	1130	44	<LOD	75	14789	129	4268	61
S124	10	1.0	9-May-07	707	31	<LOD	68	8960	75	2704	42
S124	15	1.5	9-May-07	298	19	<LOD	63	3820	36	1059	24
S125	00	GS	8-May-07	497	39	<LOD	82	10702	104	8863	107
S125	05	0.5	9-May-07	49	7	<LOD	60	559	11	166	9
S125	10	1.0	9-May-07	206	21	79	22	4627	44	2888	45
S125	15	1.5	9-May-07	87	19	87	22	3826	38	3826	51
S125	20	2.0	9-May-07	167	20	<LOD	65	4006	40	2713	43
S125	25	2.5	9-May-07	155	17	<LOD	63	3141	32	2058	34
S125	30	3.0	9-May-07	49	10	<LOD	60	1131	16	595	17
S126	00	GS	8-May-07	200	16	<LOD	63	2619	28	549	19
S126	05	0.5	9-May-07	354	17	72	20	3250	31	581	19
S126	10	1.0	9-May-07	295	14	<LOD	59	2029	22	332	15
S126	15	1.5	9-May-07	168	11	<LOD	59	1292	17	151	11
S126	20	2.0	9-May-07	178	11	<LOD	60	1419	18	245	13
S127	00	GS	8-May-07	1040	31	<LOD	73	6586	64	71	16
S127	05	0.5	9-May-07	2283	26	<LOD	60	3038	30	<LOD	31
S127	10	1.0	9-May-07	1787	30	<LOD	66	5961	53	<LOD	43
S127	15	1.5	9-May-07	1609	25	<LOD	61	4462	40	<LOD	36
S127	20	2.0	9-May-07	1982	30	<LOD	64	6110	53	<LOD	43
S127	25	2.5	9-May-07	2734	31	<LOD	61	5098	44	<LOD	31
S127	30	3.0	9-May-07	1993	29	<LOD	62	5677	48	<LOD	28
S127	35	3.5	9-May-07	1201	22	<LOD	60	3935	35	<LOD	25
S127	40	4.0	9-May-07	1927	28	<LOD	62	5394	46	<LOD	28
S127	45	4.5	9-May-07	3038	39	<LOD	66	8677	71	<LOD	36

Table 1
Summary of XRF Measurements
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)			Cadmium (Cd)			Lead (Pb)			Tungsten (W)		
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)
S128	00	GS	8-May-07	30	8	<LOD	<LOD	62	12	671	12	186	10		
S128	05	0.5	10-May-07	<LOD	5	<LOD	<LOD	48	3	23	3	<LOD	7		
S129	00	GS	8-May-07	49	11	<LOD	<LOD	61	19	1516	19	254	12		
S129	05	0.5	10-May-07	95	12	<LOD	<LOD	59	21	1941	21	500	16		
S129	10	1.0	10-May-07	99	12	<LOD	<LOD	60	20	1662	20	499	16		
S129	15	1.5	10-May-07	44	6	<LOD	<LOD	56	10	510	10	743	17		
S129	20	2.0	10-May-07	29	7	64	19	19	10	593	10	1068	20		
S129	25	2.5	10-May-07	26	6	<LOD	<LOD	57	9	452	9	732	17		
S130	00	GS	8-May-07	363	17	<LOD	<LOD	63	30	2997	30	204	15		
S130	05	0.5	9-May-07	62	5	<LOD	<LOD	56	7	266	7	32	6		
S130	10	1.0	9-May-07	21	3	<LOD	<LOD	57	5	93	5	<LOD	11		
S131	00	GS	8-May-07	245	29	115	25	25	68	7109	68	6883	82		
S131	05	0.5	10-May-07	123	18	<LOD	<LOD	65	35	3583	35	836	27		
S131	10	1.0	10-May-07	84	19	86	23	23	37	3691	37	357	24		
S132	00	GS	8-May-07	<LOD	36	<LOD	<LOD	63	21	1690	21	384	16		
S132	05	0.5	10-May-07	74	8	<LOD	<LOD	60	13	827	13	896	20		
S132	10	1.0	10-May-07	25	5	<LOD	<LOD	58	8	286	8	90	8		
S132	15	1.5	10-May-07	27	5	<LOD	<LOD	56	8	321	8	61	9		
S132	20	2.0	10-May-07	13	3	<LOD	<LOD	56	5	98	5	119	7		
S132	25	2.5	10-May-07	26	7	<LOD	<LOD	59	10	525	10	28	7		
S133	00	GS	8-May-07	24	8	<LOD	<LOD	59	12	703	12	118	9		
S133	05	0.5	10-May-07	132	24	80	22	22	56	6557	56	300	24		
S133	10	1.0	10-May-07	274	20	<LOD	<LOD	62	39	4319	39	478	20		
S133	15	1.5	10-May-07	85	9	<LOD	<LOD	60	15	1010	15	1973	30		
S133	20	2.0	10-May-07	81	10	<LOD	<LOD	62	15	947	15	1756	29		
S134	00	GS	8-May-07	20	5	<LOD	<LOD	65	7	218	7	266	12		
S134	05	0.5	9-May-07	25	3	<LOD	<LOD	57	4	49	4	26	4		
S134	10	1.0	10-May-07	11	2	<LOD	<LOD	58	3	31	3	12	4		

Table 1
Summary of XRF Measurements
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)		Cadmium (Cd)		Lead (Pb)		Tungsten (W)	
				RSRL 10 mg/Kg		RSRL 39 mg/Kg		RSRL 400 mg/Kg		RSRL None	
				NRSRL 10 mg/Kg		NRSRL 850 mg/Kg		NRSRL 800 mg/Kg		NRSRL None	
				GPL 290 mg/Kg		GPL 29 mg/Kg		GPL 290 mg/Kg		GPL - None	
				Site Specific GPL - Not Calculated		Site Specific GPL - 51 mg/Kg		Site Specific GPL - 923 mg/Kg		Site Specific GPL - Not Calculated	
XRF Analysis				XRF Analysis				XRF Analysis			
XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)
S134	15	1.5	10-May-07	11	2	<LOD	58	30	3	16	4
S135	00	GS	8-May-07	<LOD	15	<LOD	57	332	8	42	6
S135	05	0.5	10-May-07	20	5	<LOD	60	228	7	49	6
S135	10		10-May-07	12	2	<LOD	56	25	3	<LOD	10
S136	00	GS	8-May-07	<LOD	17	<LOD	56	463	9	98	8
S136	05	0.5	10-May-07	49	8	<LOD	58	702	12	435	13
S136	10	1.0	10-May-07	<LOD	14	<LOD	58	240	7	149	8
S137	00	GS	8-May-07	35	10	<LOD	60	1241	17	2789	36
S137	05	0.5	10-May-07	<LOD	26	<LOD	56	1094	14	1096	20
S137	10	1.0	10-May-07	<LOD	11	<LOD	55	146	5	220	9
S138	00	GS	8-May-07	336	38	113	25	12634	110	2622	50
S138	05	0.5	10-May-07	351	29	<LOD	66	8330	70	343	22
S138	10	1.0	10-May-07	31	7	<LOD	57	649	11	38	6
S138	15	1.5	10-May-07	18	4	<LOD	56	199	6	22	5
S139	00	GS	8-May-07	43	8	<LOD	60	888	13	136	9
S139	05	0.5	10-May-07	67	11	<LOD	60	1469	18	291	15
S139	10	1.0	10-May-07	<LOD	44	<LOD	63	2525	27	532	19
S139	15	1.5	10-May-07	30	5	<LOD	55	246	7	52	6
S140	00	GS	8-May-07	178	15	<LOD	64	2348	26	263	17
S140	05	0.5	10-May-07	<LOD	56	91	22	3817	37	447	25
S140	10	1.0	10-May-07	70	12	<LOD	62	1866	21	377	20
S140	15	1.5	10-May-07	<LOD	36	68	23	1466	20	384	28
S140	20	2.0	10-May-07	151	27	<LOD	68	7363	65	382	27
S140	25	2.5	10-May-07	203	34	81	25	9646	88	280	36
S140	30	3.0	10-May-07	<LOD	15	<LOD	55	359	8	599	15
S141	00	GS	8-May-07	<LOD	7	<LOD	58	31	3	13	4
S141	05	0.5	9-May-07	7	2	<LOD	56	30	3	<LOD	11
S142	00	GS	8-May-07	12	3	<LOD	58	71	4	<LOD	13

Table 1
Summary of XRF Measurements
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)			Cadmium (Cd)			Lead (Pb)			Tungsten (W)		
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)
S142	05	0.5	9-May-07	<LOD	6	<LOD	<LOD	56	25	25	3	<LOD	<LOD	<LOD	10
S143	00	GS	8-May-07	<LOD	13	<LOD	61	20	220	220	7	25	25	25	5
S143	05	0.5	9-May-07	19	5	<LOD	<LOD	58	323	323	8	81	81	81	7
S143	10	1.0	10-May-07	39	8	<LOD	<LOD	59	746	746	12	156	156	156	10
S143	15	1.5	10-May-07	82	10	<LOD	<LOD	58	1337	1337	17	114	114	114	11
S143	20	2.0	10-May-07	64	8	<LOD	<LOD	59	741	741	12	118	118	118	9
S143	25	2.5	10-May-07	63	9	<LOD	<LOD	60	968	968	14	171	171	171	11
S143-offset	05	0.5	10-May-07	20	5	<LOD	<LOD	57	316	316	8	36	36	36	6
S143-offset	10	1.0	10-May-07	25	8	<LOD	<LOD	58	761	761	12	96	96	96	8
S143-offset	15	1.5	10-May-07	43	9	<LOD	<LOD	58	1100	1100	15	163	163	163	10
S143-offset	20	2.0	10-May-07	54	7	<LOD	<LOD	59	571	571	11	98	98	98	8
S144	00	GS	8-May-07	<LOD	7	<LOD	<LOD	57	48	48	4	<LOD	<LOD	<LOD	11
S144	05	0.5	9-May-07	<LOD	7	<LOD	<LOD	56	35	35	3	<LOD	<LOD	<LOD	10
S145	00	GS	8-May-07	11	3	<LOD	<LOD	58	91	91	5	20	20	20	4
S145	05	0.5	9-May-07	11	3	<LOD	<LOD	57	46	46	4	<LOD	<LOD	<LOD	11
S146	00	GS	8-May-07	22	4	<LOD	<LOD	60	199	199	6	19	19	19	5
S146	05	0.5	9-May-07	8	2	<LOD	<LOD	62	27	27	4	<LOD	<LOD	<LOD	11
S147	00	GS	8-May-07	13	4	<LOD	<LOD	58	177	177	6	22	22	22	5
S147	05	0.5	9-May-07	9	2	<LOD	<LOD	58	43	43	4	<LOD	<LOD	<LOD	11
S148	00	GS	8-May-07	9	3	<LOD	<LOD	60	77	77	5	<LOD	<LOD	<LOD	13
S148	05	0.5	9-May-07	<LOD	6	<LOD	78	20	16	16	3	<LOD	<LOD	<LOD	11
S148	10	1.0	10-May-07	<LOD	5	<LOD	<LOD	49	14	14	3	<LOD	<LOD	<LOD	7
S149	00	GS	8-May-07	10	3	<LOD	<LOD	60	81	81	5	<LOD	<LOD	<LOD	12
S149	05	0.5	9-May-07	<LOD	7	<LOD	<LOD	60	27	27	3	<LOD	<LOD	<LOD	10
S150	00	GS	8-May-07	<LOD	13	<LOD	62	20	220	220	7	19	19	19	6
S150	05	0.5	9-May-07	11	3	<LOD	<LOD	57	80	80	4	<LOD	<LOD	<LOD	11

Table 1
Summary of XRF Measurements
Ore Mill Site, City of Tucson

NOTES

- Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets.
- Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
- Sample Depth The depth of the XRF or laboratory sample from the ground surface in feet. GS indicates the measurement was taken at the ground surface.
- mg/Kg milligrams per kilogram
 - RSRL Residential Soil Remediation Limit (mg/Kg).
 - NRSRL Non-residential Soil Remediation Limit (mg/Kg).
 - GPL Groundwater Protection Level
- XRF The X-ray fluorescence testing method (soil mode).
- XRF Instrument The measured concentration of a metal. If <LOD, the measured concentration was less than the instrument Limit of Detection (LOD).
- Concentration (mg/Kg)
- XRF Instrument The measured accuracy range as plus or minus a Value in mg/Kg. If the XRF measurement was 12 +/-3, the concentration of a metal by XRF could be as low as 9 mg/Kg or as high as 15 mg/Kg. If the XRF measurement Accuracy was <LOD, the detection limit is given under (+/- mg/Kg)

Source of Regulatory Concentrations

- RSRL Arizona Soil Remediation Standards Rule, May 5, 2007
- NRSRL Arizona Soil Remediation Standards Rule, May 5, 2007
- GPL Drywell Investigation Guidelines, August 2000
- Site Specific GPL A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality, Appendix C, September 1996

Table 2
Summary of Laboratory Analytical Data
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)		Cadmium (Cd)		Lead (Pb)		Tungsten (W)	
				Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Concentration (mg/Kg)	Laboratory Qualifier(*)
S101	00	GS	8-May-07	<5.0	-	4	-	250	D2	950	D2
S101	05	0.5	9-May-07	<5.0	D1	<2.5	D1	12	D1	21	D1
S102	05	0.5	9-May-07	<5.0	-	<2.5	-	56	D2	120	D2
S103	05	0.5	9-May-07	<5.0	-	3.5	-	210	D2	650	D2
S104	00	GS	8-May-07	<5.0	-	4	-	230	D2	420	D2
S104	05	0.5	9-May-07	<5.0	-	<2.5	-	22	-	76	D2
S105	05	0.5	9-May-07	5.9	D1	<2.5	D1	5.7	D1	<10	D1
S106	05	0.5	9-May-07	<5.0	D1	<2.5	D1	5.4	D1	<10	D1
S107	05	0.5	9-May-07	<5.0	-	<2.5	-	410	D2	57	D2
S108	05	0.5	9-May-07	6	D1	<2.5	D1	11	D1	<10	D1
S109	05	0.5	9-May-07	28	-	4.3	-	2100	D2	160	D2
S110	05	0.5	9-May-07	5.6	-	<2.5	-	260	D2	240	D2
S111	05	0.5	9-May-07	<5.0	-	7	-	610	D2	920	D2
S112	00	GS	8-May-07	<5.0	-	3.2	-	330	D2	460	D2
S112	05	0.5	9-May-07	9.7	D1	<2.5	D1	9.5	D1	<10	D1
S113	05	0.5	10-May-07	<5.0	-	<2.5	-	79	D2	32	-
S114	10	1.0	10-May-07	<5.0	-	140	D2	310	D2	520	D2
S115	10	1.0	10-May-07	<5.0	D1	<2.5	D1	23	D1	<10	D1
S116	05	0.5	9-May-07	17	-	2.7	-	520	D2	380	D2
S117	05	0.5	9-May-07	5.7	-	<2.5	-	740	D2	75	-
S118	05	0.5	10-May-07	5.7	-	<2.5	-	240	D2	160	D2
S119	15	1.5	10-May-07	21	-	3.1	-	2000	D2	380	D2
S120	05	0.5	10-May-07	<5.0	D1	<2.5	D1	26	D1	25	D1
S121	10	1.0	10-May-07	5.3	D1	<2.5	D1	26	D1	<10	D1
S122	00	GS	8-May-07	25	-	6.4	-	4000	D2	970	D2
S122	05	0.5	10-May-07	14	-	3.2	-	2200	D2	840	D2
S123	25	2.5	9-May-07	8	-	<2.5	-	75	D2	45	D2
S124	00	GS	8-May-07	120	D2	17	-	19000	D2	6300	D2
S124	15	1.5	9-May-07	20	-	4.8	-	2700	D2	980	D2

Table 2
Summary of Laboratory Analytical Data
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)		Cadmium (Cd)		Lead (Pb)		Tungsten (W)	
				Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Concentration (mg/Kg)	Laboratory Qualifier(*)
S125	00	GS	8-May-07	71	D2	14	-	5400	D2	3800	D2
S125	10	1.0	9-May-07	6.5	-	26	-	4900	D2	2100	D2
S125	15	1.5	9-May-07	20	-	4.8	-	2700	D2	980	D2
S125	30	3.0	9-May-07	26	-	11	-	1500	D2	1100	D2
S126	20	2.0	9-May-07	100	D2	4.8	-	1300	D2	380	D2
S127	00	GS	8-May-07	1700	D2	8.8	-	13000	D2	80	D2
S127	30	3.0	9-May-07	2300	D2	5.3	-	8600	D2	37	-
S127	45	4.5	9-May-07	2200	D2	5.5	-	6700	D2	50	-
S128	05	0.5	10-May-07	<5.0	D1	<2.5	D1	16	D1	<10	D1
S129	20	2.0	10-May-07	<5.0	-	4	-	740	D2	940	D2
S129	25	2.5	10-May-07	<5.0	-	3.8	-	700	D2	960	D2
S130	10	1.0	9-May-07	9.7	-	<2.5	-	150	D2	25	-
S131	10	1.0	10-May-07	7.1	-	70	D2	7700	D2	1200	D2
S132	25	2.5	10-May-07	<5.0	-	6.9	-	780	D2	160	D2
S133	20	2.0	10-May-07	<5.0	-	18	-	920	D2	1600	D2
S134	05	0.5	9-May-07	6.2	D1	<2.5	D1	41	D1	43	D1
S134	15	1.5	10-May-07	<5.0	D1	<2.5	D1	24	D1	17	D1
S135	10	1.0	10-May-07	<5.0	D1	<2.5	D1	33	D1	14	D1
S136	10	1.0	10-May-07	<5.0	-	<2.5	-	340	D2	260	D2
S137	10	1.0	10-May-07	5.5	-	<2.5	-	140	D2	400	D2
S138	00	GS	8-May-07	40	-	44	-	11000	D2	2600	D2
S138	15	1.5	10-May-07	<5.0	-	6.2	-	560	D2	120	D2
S139	15	1.5	10-May-07	<5.0	-	17	-	1600	D2	580	D2
S140	30	3.0	10-May-07	<5.0	-	13	-	440	D2	860	D2
S141	05	0.5	9-May-07	<5.0	D1	<2.5	D1	30	D1	13	D1
S142	00	GS	8-May-07	<5	-	<2.5	-	130	D2	64	D2
S142	05	0.5	9-May-07	5.9	D1	<2.5	D1	21	D1	<10	D1
S143	05	0.5	9-May-07	8.1	-	<2.5	-	680	D2	180	D2
S143	10	1.0	10-May-07	7.5	-	<2.5	-	690	D2	160	D2

Table 2
Summary of Laboratory Analytical Data
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Arsenic (As)			Cadmium (Cd)			Lead (Pb)			Tungsten (W)		
				Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Data	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Data	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Data	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Data
S143	15	1.5	10-May-07	16	-		4.9	-		1500	D2		260	D2	
S143	25	2.5	10-May-07	15	-		4	-		1400	D2		370	D2	
S143-offset	20	2.0	10-May-07	11	-		<2.5	-		930	D2		280	D2	
S144	05	0.5	9-May-07	<5.0	D1		<2.5	D1		28	D1		<10	D1	
S145	05	0.5	9-May-07	<5.0	D1		<2.5	D1		46	D1		<10	D1	
S146	05	0.5	9-May-07	<5.0	D1		<2.5	D1		13	D1		<10	D1	
S147	05	0.5	9-May-07	7.1	D1		<2.5	D1		27	D1		<10	D1	
S148	05	0.5	9-May-07	5.5	D1		<2.5	D1		8.2	D1		<10	D1	
S148	10	1.0	10-May-07	<5.0	D1		<2.5	D1		<5	D1		<10	D1	
S149	05	0.5	9-May-07	<5.0	D1		<2.5	D1		19	D1		<10	D1	
S150	05	0.5	9-May-07	<5.0	D1		<2.5	D1		71	D1		<10	D1	

Table 2
Summary of Laboratory Analytical Data
Ore Mill Site, City of Tucson

NOTES

- Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets.
- Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
- Sample Depth The depth of the XRF or laboratory sample from the ground surface in feet. GS means ground surface.
mg/Kg milligrams per kilogram
- RSRL Residential Soil Remediation Limit (mg/Kg)
- NRSRL Non-residential Soil Remediation Limit (mg/Kg)
- GPL Groundwater Protection Level
- BOLD and Right** Indicates that the concentration of the metal in the confirmatory laboratory sample exceeded the RSRL.
- Italic and Right* Indicates that the concentration of the metal in the non-confirmatory laboratory sample exceeded the RSRL.

Laboratory Qualifiers

- D1 Sample required dilution due to matrix.
- D2 Sample required dilution due to high concentration of target analyte.
- T2 Cited ADHS License method does not contain this analyte as part of the method compound list.
- (*) All Tungsten samples qualified T2.
- No Data Qualifier

Source of Regulatory Concentrations

- RSRL Arizona Soil Remediation Standards Rule, May 5, 2007
- NRSRL Arizona Soil Remediation Standards Rule, May 5, 2007
- GPL Drywell Investigation Guidelines, August 2000
- Site Specific GPL A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality, Appendix C, September 1996

Table 3
Comparision of XRF Measurements to Laboratory Data
Ore Mill Site, City of Tucson

				Arsenic (As)				Cadmium (Cd)				Lead (Pb)				Tungsten (W)			
				RSRL 10 mg/Kg				RSRL 39 mg/Kg				RSRL 400 mg/Kg				RSRL None			
				NRSRL 10 mg/Kg				NRSRL 850 mg/Kg				NRSRL 800 mg/Kg				NRSRL None			
				GPL 290 mg/Kg				GPL 29 mg/Kg				GPL 290 mg/Kg				GPL - None			
				Site Specific GPL - Not Calculated				Site Specific GPL - 64.1 mg/Kg				Site Specific GPL - 1611 mg/Kg				Site Specific GPL - Not Calculated			
Location ID	Depth ID	Sample Depth (feet)	Date	XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data	
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier(*)
S101	00	GS	8-May-07	<LOD	15	<5.0	-	<LOD	63	4	-	237	7	250	D2	580	16	950	D2
S101	05	0.5	9-May-07	<LOD	7	<5.0	D1	<LOD	61	<2.5	D1	22	3	12	D1	14	4	21	D1
S102	00	GS	8-May-07	126	19			<LOD	65			3854	38			873	25		
S102	05	0.5	9-May-07	12	3	<5.0	-	<LOD	59	<2.5	-	50	4	55	D2	64	6	120	D2
S103	00	GS	8-May-07	<LOD	24			<LOD	64			683	13			640	21		
S103	05	0.5	9-May-07	<LOD	5	<5.0	-	<LOD	46	3.5	-	22	3	210	D2	12	3	650	D2
S104	00	GS	8-May-07	<LOD	13	<5.0	-	<LOD	59	4	-	205	6	230	D2	268	11	420	D2
S104	05	0.5	9-May-07	<LOD	5	<5.0	-	<LOD	46	<2.5	-	24	3	22	-	<LOD	8	76	D2
S105	00	GS	8-May-07	26	8			<LOD	62			619	12			587	17		
S105	05	0.5	9-May-07	<LOD	10	5.9	D1	<LOD	48	<2.5	D1	170	5	5.7	D1	102	6	<10	D1
S105	10	1.0	9-May-07	<LOD	4			<LOD	46			14	2			<LOD	6		
S106	00	GS	8-May-07	<LOD	45			<LOD	62			2655	28			186	15		
S106	05	0.5	9-May-07	<LOD	4	<5.0	D1	<LOD	48	<2.5	D1	16	3	5.4	D1	<LOD	7	<10	D1
S107	00	GS	8-May-07	<LOD	65			<LOD	69			4654	46			170	23		
S107	05	0.5	9-May-07	<LOD	5	<5.0	-	<LOD	46	<2.5	-	27	3	415	D2	<LOD	7	57	D2
S108	00	GS	8-May-07	<LOD	37			<LOD	61			1834	21			469	17		
S108	05	0.5	9-May-07	<LOD	5	6	D1	<LOD	47	<2.5	D1	20	3	11	D1	<LOD	8	<10	D1
S109	00	GS	8-May-07	<LOD	42			<LOD	63			2239	25			199	16		
S109	05	0.5	9-May-07	<LOD	5	25	-	<LOD	46	4.3	-	30	3	2100	D2	<LOD	8	160	D2
S110	00	GS	8-May-07	<LOD	19			59	19			507	10			41	7		
S110	05	0.5	9-May-07	<LOD	5	5.8	-	<LOD	46	<2.5	-	30	3	260	D2	<LOD	8	240	D2
S111	00	GS	8-May-07	130	29			<LOD	72			7604	70			379	30		
S111	05	0.5	9-May-07	<LOD	5	<5.0	-	<LOD	48	7	-	16	3	510	D2	<LOD	7	920	D2
S112	00	GS	8-May-07	28	6	<5.0	-	<LOD	62	3.2	-	416	9	330	D2	202	10	460	D2
S112	05	0.5	9-May-07	<LOD	4	9.7	D1	<LOD	48	<2.5	D1	13	2	9.5	D1	<LOD	7	<10	D1
S113	00	GS	8-May-07	30	8			<LOD	63			755	13			46	9		
S113	05	0.5	10-May-07	<LOD	5	<5.0	-	<LOD	47	<2.5	-	17	3	79	D2	<LOD	8	32	-
S113	10	1.0	10-May-07	<LOD	4			<LOD	46			16	2			<LOD	6		
S114	00	GS	8-May-07	456	33			87	24			10066	86			1174	34		
S114	05	0.5	10-May-07	<LOD	15			<LOD	48			397	8			913	17		
S114	10	1.0	10-May-07	<LOD	5	<5.0	-	<LOD	47	140	D2	38	3	310	D2	34	4	520	D2
S115	00	GS	8-May-07	94	14			64	21			2201	25			171	14		
S115	05	0.5	10-May-07	19	3			<LOD	46			179	5			<LOD	9		
S115	10	1.0	10-May-07	<LOD	5	<5.0	D1	<LOD	46	<2.5	D1	24	3	23	D1	<LOD	7	<10	D1
S116	00	GS	8-May-07	<LOD	34			<LOD	63			1448	19			326	15		
S116	05	0.5	9-May-07	<LOD	5	17	-	<LOD	47	2.7	-	31	3	520	D2	<LOD	8	390	D2
S117	00	GS	8-May-07	<LOD	26			<LOD	60			943	14			60	8		
S117	05	0.5	9-May-07	<LOD	6	5.7	-	<LOD	48	<2.5	-	31	3	740	D2	<LOD	8	75	-
S118	00	GS	8-May-07	<LOD	24			69	19			829	13			412	13		
S118	05	0.5	10-May-07	<LOD	5	5.7	-	<LOD	46	<2.5	-	22	3	240	D2	<LOD	7	160	D2
S119	00	GS	8-May-07	80	13			65	21			2125	24			102	13		
S119	05	0.5	10-May-07	737	43			<LOD	79			12951	122			<LOD	130		
S119	10	1.0	10-May-07	204	50			<LOD	80			18355	166			<LOD	125		
S119	15	1.5	10-May-07	<LOD	16	31	-	<LOD	56	3.1	-	350	8	2000	D2	160	9	390	D2
S119	30	3.0	10-May-07	12	3			<LOD	57			57	4			<LOD	10		
S120	00	GS	8-May-07	<LOD	26			<LOD	61			907	14			137	10		
S120	05	0.5	10-May-07	<LOD	5	<5.0	D1	<LOD	47	<2.5	D1	25	3	26	D1	<LOD	8	25	D1
S121	00	GS	8-May-07	<LOD	40			<LOD	61			2212	24			133	14		
S121	05	0.5	10-May-07	14	4			<LOD	46			221	6			21	4		
S121	10	1.0	10-May-07	<LOD	6	5.3	D1	<LOD	46	<2.5	D1	36	3	26	D1	<LOD	8	<10	D1
S122	00	GS	8-May-07	<LOD	45	25	-	66	21	6.4	-	2656	28	4000	D2	456	17	970	D2
S122	05	0.5	10-May-07	<LOD	8	14	-	<LOD	47	3.2	-	102	4	2200	D2	168	8	640	D2

Table 3
Comparision of XRF Measurements to Laboratory Data
Ore Mill Site, City of Tucson

				Arsenic (As)				Cadmium (Cd)				Lead (Pb)				Tungsten (W)			
				RSRL 10 mg/Kg				RSRL 39 mg/Kg				RSRL 400 mg/Kg				RSRL None			
				NRSRL 10 mg/Kg				NRSRL 850 mg/Kg				NRSRL 800 mg/Kg				NRSRL None			
				GPL 290 mg/Kg				GPL 29 mg/Kg				GPL 290 mg/Kg				GPL - None			
				Site Specific GPL - Not Calculated				Site Specific GPL - 64.1 mg/Kg				Site Specific GPL - 1611 mg/Kg				Site Specific GPL - Not Calculated			
Location ID	Depth ID	Sample Depth (feet)	Date	XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data	
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier(*)
S123	00	GS	8-May-07	201	16			<LOD	67			2539	29			6773	71		
S123	05	0.5	9-May-07	15	3			<LOD	55			109	5			57	5		
S123	10	1.0	9-May-07	20	3			<LOD	55			111	5			66	7		
S123	15	1.5	9-May-07	16	3			<LOD	56			101	5			51	5		
S123	20	2.0	9-May-07	10	3			<LOD	56			56	4			28	4		
S123	25	2.5	9-May-07	9	3	8	-	<LOD	56	<2.5	-	60	4	75	D2	23	4	45	D2
S124	00	GS	8-May-07	613	44	120	D2	<LOD	77	17	-	14892	132	19000	D2	3233	54	6300	D2
S124	05	0.5	9-May-07	1130	44			<LOD	75			14789	129			4268	61		
S124	10	1.0	9-May-07	707	31			<LOD	68			8960	75			2704	42		
S124	15	1.5	9-May-07	298	19	20	-	<LOD	63	4.8	-	3820	36	2700	D2	1059	24	980	D2
S125	00	GS	8-May-07	497	39	71	D2	<LOD	82	14	-	10702	104	5400	D2	8863	107	3800	D2
S125	05	0.5	9-May-07	49	7			<LOD	60			559	11			166	9		
S125	10	1.0	9-May-07	206	21	6.5	-	79	22	26	-	4627	44	4900	D2	2888	45	2100	D2
S125	15	1.5	9-May-07	87	19	20	-	87	22	4.8	-	3826	38	2700	D2	3826	51	980	D2
S125	20	2.0	9-May-07	167	20			<LOD	65			4006	40			2713	43		
S125	25	2.5	9-May-07	155	17			<LOD	63			3141	32			2058	34		
S125	30	3.0	9-May-07	49	10	26	-	<LOD	60	11	-	1131	16	1500	D2	595	17	1100	D2
S126	00	GS	8-May-07	200	16			<LOD	63			2619	28			549	19		
S126	05	0.5	9-May-07	354	17			72	20			3250	31			581	19		
S126	10	1.0	9-May-07	295	14			<LOD	59			2029	22			332	15		
S126	15	1.5	9-May-07	168	11			<LOD	59			1292	17			151	11		
S126	20	2.0	9-May-07	178	11	100	D2	<LOD	60	4.8	-	1419	18	1300	D2	245	13	380	D2
S127	00	GS	8-May-07	1040	31	1700	D2	<LOD	73	8.8	-	6586	64	13000	D2	71	16	80	D2
S127	05	0.5	9-May-07	2283	26			<LOD	60			3038	30			<LOD	31		
S127	10	1.0	9-May-07	1787	30			<LOD	66			5961	53			<LOD	43		
S127	15	1.5	9-May-07	1609	25			<LOD	61			4462	40			<LOD	36		
S127	20	2.0	9-May-07	1982	30			<LOD	64			6110	53			<LOD	43		
S127	25	2.5	9-May-07	2734	31			<LOD	61			5098	44			<LOD	31		
S127	30	3.0	9-May-07	1993	29	2300	D2	<LOD	62	5.3	-	5677	48	8600	D2	<LOD	28	37	
S127	35	3.5	9-May-07	1201	22			<LOD	60			3935	35			<LOD	25		
S127	40	4.0	9-May-07	1927	28			<LOD	62			5394	46			<LOD	28		
S127	45	4.5	9-May-07	3038	39	2200	D2	<LOD	66	5.5	-	8677	71	6700	D2	<LOD	36	50	-
S128	00	GS	8-May-07	30	8			<LOD	62			671	12			186	10		
S128	05	0.5	10-May-07	<LOD	5	<5.0	D1	<LOD	48	<2.5	D1	23	3	16	D1	<LOD	7	<10	D1
S129	00	GS	8-May-07	49	11			<LOD	61			1516	19			254	12		
S129	05	0.5	10-May-07	95	12			<LOD	59			1941	21			500	16		
S129	10	1.0	10-May-07	99	12			<LOD	60			1662	20			499	16		
S129	15	1.5	10-May-07	44	6			<LOD	56			510	10			743	17		
S129	20	2.0	10-May-07	29	7	<5.0	-	64	19	4	-	593	10	740	D2	1068	20	940	D2
S129	25	2.5	10-May-07	26	6	<5.0	-	<LOD	57	3.8	-	452	9	700	D2	732	17	960	D2
S130	00	GS	8-May-07	363	17			<LOD	63			2997	30			204	15		
S130	05	0.5	9-May-07	62	5			<LOD	56			266	7			32	6		
S130	10	1.0	9-May-07	21	3	9.7	-	<LOD	57	<2.5	-	93	5	150	D2	<LOD	11	25	-
S131	00	GS	8-May-07	245	29			115	25			7109	68			6883	82		
S131	05	0.5	10-May-07	123	18			<LOD	65			3583	35			836	27		
S131	10	1.0	10-May-07	84	19	7.1	-	86	23	70	D2	3691	37	7700	D2	357	24	1200	D2
S132	00	GS	8-May-07	<LOD	36			<LOD	63			1690	21			384	16		
S132	05	0.5	10-May-07	74	8			<LOD	60			827	13			896	20		
S132	10	1.0	10-May-07	25	5			<LOD	58			286	8			90	8		
S132	15	1.5	10-May-07	27	5			<LOD	56			321	8			61	9		
S132	20	2.0	10-May-07	13	3			<LOD	56			98	5			119	7		
S132	25	2.5	10-May-07	26	7	<5.0	-	<LOD	59	6.9	-	525	10	780	D2	28	7	160	D2

Table 3
Comparison of XRF Measurements to Laboratory Data
Ore Mill Site, City of Tucson

				Arsenic (As)				Cadmium (Cd)				Lead (Pb)				Tungsten (W)			
				RSRL 10 mg/Kg				RSRL 39 mg/Kg				RSRL 400 mg/Kg				RSRL None			
				NRSRL 10 mg/Kg				NRSRL 850 mg/Kg				NRSRL 800 mg/Kg				NRSRL None			
				GPL 290 mg/Kg				GPL 29 mg/Kg				GPL 290 mg/Kg				GPL - None			
				Site Specific GPL - Not Calculated				Site Specific GPL - 64.1 mg/Kg				Site Specific GPL - 1611 mg/Kg				Site Specific GPL - Not Calculated			
Location ID	Depth ID	Sample Depth (feet)	Date	XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data	
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier(*)
S133	00	GS	8-May-07	24	8			<LOD	59			703	12			118	9		
S133	05	0.5	10-May-07	132	24			80	22			6557	56			300	24		
S133	10	1.0	10-May-07	274	20			<LOD	62			4319	39			478	20		
S133	15	1.5	10-May-07	85	9			<LOD	60			1010	15			1973	30		
S133	20	2.0	10-May-07	81	10	<5.0	-	<LOD	62	18	-	947	15	920	D2	1756	29	1600	D2
S134	00	GS	8-May-07	20	5			<LOD	65			218	7			266	12		
S134	05	0.5	9-May-07	25	3	6.2	D1	<LOD	57	<2.5	D1	49	4	41	D1	26	4	43	D1
S134	10	1.0	10-May-07	11	2			<LOD	58			31	3			12	4		
S134	15	1.5	10-May-07	11	2	<5.0	D1	<LOD	58	<2.5	D1	30	3	24	D1	16	4	17	D1
S135	00	GS	8-May-07	<LOD	15			<LOD	57			332	8			42	6		
S135	05	0.5	10-May-07	20	5			<LOD	60			228	7			49	6		
S135	10	1.0	10-May-07	12	2	<5.0	D1	<LOD	56	<2.5	D1	25	3	33	D1	<LOD	10	14	D1
S136	00	GS	8-May-07	<LOD	17			<LOD	56			463	9			98	8		
S136	05	0.5	10-May-07	49	8			<LOD	58			702	12			435	13		
S136	10	1.0	10-May-07	<LOD	14	<5.0	-	<LOD	58	<2.5	-	240	7	340	D2	149	8	260	D2
S137	00	GS	8-May-07	35	10			<LOD	60			1241	17			2789	36		
S137	05	0.5	10-May-07	<LOD	26			<LOD	56			1094	14			1096	20		
S137	10	1.0	10-May-07	<LOD	11	5.5	-	<LOD	55	<2.5	-	146	5	140	D2	220	9	400	D2
S138	00	GS	8-May-07	336	38	40	-	113	25	44	-	12634	110	11000	D2	2622	50	2600	D2
S138	05	0.5	10-May-07	351	29			<LOD	66			8330	70			343	22		
S138	10	1.0	10-May-07	31	7			<LOD	57			649	11			38	6		
S138	15	1.5	10-May-07	18	4	<5.0	-	<LOD	56	6.2	-	199	6	560	D2	22	5	120	D2
S139	00	GS	8-May-07	43	8			<LOD	60			888	13			136	9		
S139	05	0.5	10-May-07	67	11			<LOD	60			1469	18			291	15		
S139	10	1.0	10-May-07	<LOD	44			<LOD	63			2525	27			532	19		
S139	15	1.5	10-May-07	30	5	<5.0	-	<LOD	55	17	-	246	7	1600	D2	52	6	580	D2
S140	00	GS	8-May-07	178	15			<LOD	64			2348	26			263	17		
S140	05	0.5	10-May-07	<LOD	56			91	22			3817	37			447	25		
S140	10	1.0	10-May-07	70	12			<LOD	62			1866	21			377	20		
S140	15	1.5	10-May-07	<LOD	36			68	23			1466	20			384	28		
S140	20	2.0	10-May-07	151	27			<LOD	68			7363	65			382	27		
S140	25	2.5	10-May-07	203	34			81	25			9646	88			280	36		
S140	30	3.0	10-May-07	<LOD	15	<5.0	-	<LOD	55	13	-	359	3	400	D2	599	15	890	D2
S141	00	GS	8-May-07	<LOD	7			<LOD	58			31	3			13	4		
S141	05	0.5	9-May-07	7	2	<5.0	D1	<LOD	56	<2.5	D1	30	3	30	D1	<LOD	11	13	D1
S142	00	GS	8-May-07	12	3	<5	-	<LOD	58	<2.5	-	71	4	130	D2	<LOD	13	64	D2
S142	05	0.5	9-May-07	<LOD	6	5.9	D1	<LOD	56	<2.5	D1	25	3	21	D1	<LOD	10	<10	D1
S143	00	GS	8-May-07	<LOD	13			61	20			220	7			25	5		
S143	05	0.5	9-May-07	19	5	8.1	-	<LOD	58	<2.5	-	323	8	680	D2	81	7	180	D2
S143	10	1.0	10-May-07	39	8	7.5	-	<LOD	59	<2.5	-	746	12	690	D2	156	10	160	D2
S143	15	1.5	10-May-07	82	10	16	-	<LOD	58	4.9	-	1337	17	1500	D2	114	11	260	D2
S143	20	2.0	10-May-07	64	8			<LOD	59			741	12			118	9		
S143	25	2.5	10-May-07	63	9	15	-	<LOD	60	4	-	968	14	1400	D2	171	11	370	D2
S143-offset	05	0.5	10-May-07	20	5			<LOD	57			316	8			36	6		
S143-offset	10	1.0	10-May-07	25	8			<LOD	58			761	12			96	8		
S143-offset	15	1.5	10-May-07	43	9			<LOD	58			1100	15			163	10		
S143-offset	20	2.0	10-May-07	54	7	11	-	<LOD	59	<2.5	-	571	11	930	D2	98	8	280	D2
S144	00	GS	8-May-07	<LOD	7			<LOD	57			48	4			<LOD	11		
S144	05	0.5	9-May-07	<LOD	7	<5.0	D1	<LOD	56	<2.5	D1	35	3	28	D1	<LOD	10	<10	D1
S145	00	GS	8-May-07	11	3			<LOD	58			91	5			20	4		
S145	05	0.5	9-May-07	11	3	<5.0	D1	<LOD	57	<2.5	D1	46	4	46	D1	<LOD	11	<10	D1
S146	00	GS	8-May-07	22	4			<LOD	60			199	6			19	5		

Table 3
Comparision of XRF Measurements to Laboratory Data
Ore Mill Site, City of Tucson

				Arsenic (As)				Cadmium (Cd)				Lead (Pb)				Tungsten (W)			
				RSRL 10 mg/Kg				RSRL 39 mg/Kg				RSRL 400 mg/Kg				RSRL None			
				NRSRL 10 mg/Kg				NRSRL 850 mg/Kg				NRSRL 800 mg/Kg				NRSRL None			
				GPL 290 mg/Kg				GPL 29 mg/Kg				GPL 290 mg/Kg				GPL - None			
				Site Specific GPL - Not Calculated				Site Specific GPL - 64.1 mg/Kg				Site Specific GPL - 1611 mg/Kg				Site Specific GPL - Not Calculated			
Location ID	Depth ID	Sample Depth (feet)	Date	XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data		XRF Analysis		Laboratory Data	
				XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier	XRF Instrument Concentration (mg/Kg)	XRF Instrument Accuracy (+/- mg/Kg)	Laboratory Concentration (mg/Kg)	Laboratory Qualifier(*)
S146	05	0.5	9-May-07	8	2	<5.0	D1	<LOD	62	<2.5	D1	27	4	13	D1	<LOD	11	<10	D1
S147	00	GS	8-May-07	13	4			<LOD	58			177	6			22	5		
S147	05	0.5	9-May-07	9	2	7.1	D1	<LOD	58	<2.5	D1	43	4	27	D1	<LOD	11	<10	D1
S148	00	GS	8-May-07	9	3			<LOD	60			77	5			<LOD	13		
S148	05	0.5	9-May-07	<LOD	6	5.5	D1	78	20	<2.5	D1	16	3	8.2	D1	<LOD	11	<10	D1
S148	10	1.0	10-May-07	<LOD	5	<5.0	D1	<LOD	49	<2.5	D1	14	3	<5	D1	<LOD	7	<10	D1
S149	00	GS	8-May-07	10	3			<LOD	60			81	5			<LOD	12		
S149	05	0.5	9-May-07	<LOD	7	<5.0	D1	<LOD	60	<2.5	D1	27	3	19	D1	<LOD	10	<10	D1
S150	00	GS	8-May-07	<LOD	13			62	20			220	7			19	6		
S150	05	0.5	9-May-07	11	3	<5.0	D1	<LOD	57	<2.5	D1	80	4	71	D1	<LOD	11	<10	D1

NOTES

Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets.
Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
Sample Depth The depth of the XRF or laboratory sample from the ground surface in feet. GS means ground surface.
XRF The X-ray fluorescence testing method (soil mode).
mg/Kg milligrams per kilogram
RSRL Residential Soil Remediation Limit (mg/Kg)
NRSRL Non-residential Soil Remediation Limit (mg/Kg)
GPL Groundwater Protection Level
XRF Instrument Concentration (mg/Kg) The measured concentration of a metal. If <LOD, the measured concentration was less than the instrument Limit of Detection (LOD).
XRF Instrument Accuracy (+/- mg/Kg) The measured accuracy range as plus or minus a Value in mg/Kg. If the measurement was 12 +/-3, the concentration of a metal could be as low as 9 mg/Kg or as high as 15 mg/Kg. If the measurement was <LOD, the detection limit is given under the XRF Instrument Accuracy column. If the measurement was <LOD 10, the concetration of the metal in the soil was less than 10 mg/Kg.

Laboratory Qualifiers

D1 Sample required dilution due to matrix.
D2 Sample required dilution due to high concentration of target analyte.
T2 Cited ADHS License method does not contain this analyte as part of the method compound list.
(*) All samples for Tungsten were qualified T2.
- No Data Qualifier

Source of Regulatory Concentrations

RSRL Arizona Soil Remediation Standards Rule, May 5, 2007
NRSRL Arizona Soil Remediation Standards Rule, May 5, 2007
GPL Drywell Investigation Guidelines, August 2000
Site Specific
GPL A Screening Method to Determine Soil Concnetrations Protective of Groundwater Quality, Appendix C, September 1996

Field rational for collection of laboratory confirmation soil sample

collected due to refusal of direct push or manual excavation

XRF measurement - concentration met the criteria of Pb<400, As +/-10 mg/Kg

XRF measurement - concentration met the criteria of Pb<400, As +/-10 mg/Kg
Confirmatory Lab concentration reported Pb>400 mg/Kg
Kleinfelder requested re-analysis/retesting by AeroTech for As, Pb (May 31, 2007)

Table 4
Comparison of Laboratory Duplicates
Ore Mill Site, City of Tucson

Location	Depth ID	Sample Depth (feet)	Date	Arsenic (As)		Cadmium (Cd)		Lead (Pb)		Tungsten (W)	
				Concentration (mg/Kg)	Qualifier	Concentration (mg/Kg)	Qualifier	Concentration (mg/Kg)	Qualifier	Concentration (mg/Kg)	Qualifier (*)
S105	05	0.5	9-May-07	5.9	D1	<2.5	D1	5.7	D1	<10	D1
SD004	05			6	D1	<2.5	D1	16	D1	19	D1
S112	00	GS	8-May-07	<5.0	-	3.2	-	330	D2	460	D2
SD003	00			<5.0	-	3.7	-	330	D2	490	D2
S113	05	0.5	10-May-07	<5.0	-	<2.5	-	79	D2	32	-
SD007	05			8.5	-	<2.5	-	110	D2	45	-
S125	00	GS	8-May-07	71	D2	14	-	5400	D2	3800	D2
SD002	00			61	D2	14	-	5300	D2	3800	D2
S127	00	0	8-May-07	1700	D2	8.8	-	13000	D2	80	D2
SD001	00			1800	D2	8.5	-	9500	D2	71	D2
S143	25	2.5	10-May-07	15	-	4	-	1400	D2	370	D2
SD006	20(+)			13	-	4.2	-	1300	D2	350	D2
S148	05	0.5	9-May-07	5.5	D1	<2.5	D1	8.2	D1	<10	D1
SD005	05			<5.0	D1	<2.5	D1	8.1	D1	23	D1

NOTES

Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets. SD prefix indicates Sample Duplicate
Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
Sample Depth The depth of the XRF or laboratory sample from the ground surface in feet. GS means ground surface.
mg/Kg milligrams per kilogram

Laboratory Qualifiers

D1 Sample required dilution due to matrix.
D2 Sample required dilution due to high concentration of target analyte.
T2 Cited ADHS License method does not contain this analyte as part of the method compound list.
(*) All samples for Tungsten were qualified T2.
(+) The depth ID on the laboratory Chain of Custody written as 20. The sample was collected at a sample depth of 2.5 feet.

Table 5
Rationale for the Collection of Additional Soil Samples
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Rational for the Collection of an Additional Soil Sample for statistical analysis
S101	00	GS	8-May-07	Lead concentration by XRF at less than the RSRL for lead
S104	00	GS	8-May-07	Lead concentration by XRF at less than the RSRL for lead
S112	00	GS	8-May-07	Lead concentration by XRF approximately equal to the RSRL for lead
S122	00	GS	8-May-07	Lead concentration by XRF at greater than the RSRL for lead
S124	00	GS	8-May-07	Lead concentration by XRF at greater than the RSRL for lead, Arsenic concentration by XRF at greater than the RSRL for arsenic, Tungsten concentration above average
S125	00	GS	8-May-07	Lead concentration by XRF at greater than the RSRL for lead, Arsenic concentration by XRF at greater than the RSRL for arsenic, Tungsten concentration above average
S125	10	1	9-May-07	Concentrations of As, Cd, Pb, W detected by XRF
S125	15	1.5	9-May-07	Concentrations of As, Cd, Pb, W detected by XRF
S127	00	GS	8-May-07	Lead concentration by XRF at greater than the RSRL for lead, Arsenic concentration by XRF at greater than the RSRL for arsenic
S127	30	3	9-May-07	Original planned bottom of boring prior to XRF analysis, Lead concentration by XRF at greater than the RSRL for lead, Arsenic concentration by XRF at greater than the RSRL for arsenic
S129	20	2	10-May-07	Concentrations of As, Cd, Pb, W detected by XRF
S134	05	0.5	9-May-07	Lead concentration by XRF at less than the RSRL for lead, Arsenic concentration by XRF at greater than the RSRL for arsenic
S138	00	GS	8-May-07	Concentrations of As, Cd, Pb, W detected by XRF
S142	00	GS	8-May-07	Lead concentration by XRF at less than the RSRL for lead, Arsenic concentration by XRF approximately equal to the RSRL for arsenic
S143	05	0.5	9-May-07	Vertical Characterization of the Soil at Western Drainage in the Wash
S143	10	1	10-May-07	Vertical Characterization of the Soil at Western Drainage in the Wash
S143	15	1.5	10-May-07	Vertical Characterization of the Soil at Western Drainage in the Wash
S148	05	0.5	9-May-07	Cadmium concentration by XRF approximately equal to the detection limit for cadmium

NOTES

Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets.
Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
Sample Depth The depth of the XRF or laboratory sample from the ground surface in feet. GS means ground surface.
XRF The X-ray fluorescence testing method (soil mode).
RSRL Residential Soil Remediation Limit (mg/Kg)
As Arsenic
Cd Cadmium
Pb Lead
W Tungsten

Table 6
Least Squares Regression Analysis
Ore Mill Site, City of Tucson

XRF measurements and Laboratory Data used in the Least Squares Regressive Analysis							
Aresenic (As)		Cadmium (Cd)		Lead (Pb)		Tungston (W)	
Laboratory (mg/Kg)	XRF (mg/Kg)	Laboratory (mg/Kg)	XRF (mg/Kg)	Laboratory (mg/Kg)	XRF (mg/Kg)	Laboratory (mg/Kg)	XRF (mg/Kg)
8	9	6.4	66	250	237	950	580
120	613	26	79	12	22	21	14
20	298	4.8	87	56	50	120	64
71	497	4	64	210	22	650	12
6.5	206	70	86	230	205	420	268
20	87	44	113	22	24	460	202
26	49			5.7	170	520	34
100	178			5.4	16	380	160
1700	1040			410	27	970	456
2300	1993			11	20	840	188
2200	3038			2100	30	45	23
9.7	21			260	30	6300	3233
7.1	84			610	16	980	1059
6.2	25			330	416	3800	8863
40	336			9.5	13	2100	2888
8.1	19			79	17	980	3826
7.5	39			310	38	1100	595
16	82			23	24	380	245
15	63			520	21	80	71
11	54			740	31	940	1068
7.1	9			240	22	960	732
				2000	359	1200	357
				26	25	160	28
				26	36	1600	1756
				4000	2656	43	26
				2200	102	17	16
				75	60	260	149
				19000	14892	400	220
				2700	3820	2600	2622
				5400	10702	120	22
				4900	4627	580	52
				2700	3826	860	599
				1500	1131	180	81
				1300	1419	160	156
				13000	6586	260	114
				8600	5677	370	171
				6700	8677	280	98
				16	23		
				740	593		
				700	452		
				150	93		
				7700	3691		
				780	525		
				920	947		
				41	49		
				24	30		
				33	25		
				340	240		
				140	146		
				11000	12634		
				560	199		
				1600	246		
				440	359		
				30	30		
				130	71		
				21	25		
				680	323		
				690	746		
				1500	1337		
				1400	968		
				930	571		
				28	35		
				46	46		
				13	27		
				27	43		
				8.2	16		
				19	27		
				71	80		

Least Squares Result	
Slope of the best fit line	
As	0.909
Cd	1.415
Pb	1.109
W	0.704

Least Squares Result	
Intercept	
As	-59.390
Cd	-90.832
Pb	159.263
W	276.778

Least Squares Result	
R ²	
As	0.877
Cd	0.889
Pb	0.980
W	0.956

NOTES

XRF XRF Measurement
Laboratory Laboratory Data
mg/Kg milligrams per kilogram
As Arsenic
Cd Cadmium
Pb Lead
W Tungsten

Table 7
Comparison of Initial and Reanalyzed Laboratory Data for Arsenic and Lead
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	Laboratory Data		Laboratory Data	
				Laboratory Concentration (mg/Kg)	Laboratory Qualifier	Laboratory Concentration (mg/Kg)	Laboratory Qualifier
S107	05	0.5	9-May-07	<5.0	-	410	D2
			6-Jun-07	<5.0	-	640	-
S109	05	0.5	9-May-07	28	-	2100	D2
			6-Jun-07	19	-	2300	-
S111	05	0.5	9-May-07	<5.0	-	610	D2
			6-Jun-07	6.9	-	400	-
S116	05	0.5	9-May-07	17	-	520	D2
			6-Jun-07	15	-	500	-
S117	05	0.5	9-May-07	5.7	-	740	D2
			6-Jun-07	9.4	-	1400	-
S119	15	1.5	10-May-07	21	-	2000	D2
			6-Jun-07	21	-	1800	-
S122	05	0.5	10-May-07	14	-	2200	D2
			6-Jun-07	10	-	1600	-
S140	30	3.0	10-May-07	<5.0	-	440	D2
			6-Jun-07	<5	-	350	-

NOTES

Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets.
Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
Sample Depth The depth of the XRF or laboratory sample from the ground surface in feet. GS means ground surface.
mg/Kg milligrams per kilogram
RSRL Residential Soil Remediation Limit (mg/Kg)
NRSRL Non-residential Soil Remediation Limit (mg/Kg)
GPL Groundwater Protection Level

Laboratory Qualifiers

D2 Sample required dilution due to high concentration of target analyte.
- No Data Qualifier

Source of Regulatory Concentrations

RSRL Arizona Soil Remediation Standards Rule, May 5, 2007
NRSRL Arizona Soil Remediation Standards Rule, May 5, 2007
GPL Drywell Investigation Guidelines, August 2000
Site Specific GPL, Screening Method to Determine Soil Concentrations Protective of Groundwater Quality, Appendix C, September 199

Table 8
Summary of TCLP Analytical Data
Ore Mill Site, City of Tucson

Location ID	Depth ID	Sample Depth (feet)	Date	TCLP Data				Corresponding Soil Data	
				Arsenic (As) MCCTC 5.0 (mg/L)	Cadmium (Cd) MCCTC 1.0 (mg/L)	Lead (Pb) MCCTC 5.0 (mg/L)	Cadmium (Cd)		
				Laboratory Concentration (mg/L)	Laboratory Concentration (mg/L)	Laboratory Concentration (mg/L)	Soil Laboratory Concentration (mg/kg)	Soil Laboratory Concentration (mg/kg)	Soil Laboratory Concentration (mg/kg)
S102	05	0.5	9-May-07	<0.50	<0.25	<0.50	<2.5		56
S103	05	0.5	9-May-07	<0.50	<0.25	<0.50	3.5		210
S107	05	0.5	9-May-07	<0.50	<0.25	<0.50	<2.5		410
S113	05	0.5	10-May-07	<0.50	<0.25	<0.50	<2.5		79
S114	10	1.0	10-May-07	<0.50	<0.25	<0.50	140		310
S116	05	0.5	9-May-07	<0.50	<0.25	<0.50	2.7		520
S119	15	1.5	10-May-07	<0.50	<0.25	<0.50	3.1		2,000
S122	00	GS	8-May-07	<0.50	<0.25	4.9	6.4		4,000
S122	05	0.5	10-May-07	<0.50	<0.25	0.52	3.2		2,200
S123	25	2.5	9-May-07	<0.50	<0.25	<0.50	<2.5		75
S127	00	GS	8-May-07	<0.50	<0.25		84*		13,000
S127	30	3.0	9-May-07	<0.50	<0.25		12*		8,800
S127	45	4.5	9-May-07	<0.50	<0.25	1.7	5.5		6,700
S130	10	1.0	9-May-07	<0.50	<0.25				150
S131	10	1.0	10-May-07	<0.50	1.6*	0.63	70*		7,700
S138	00	GS	8-May-07	<0.50	0.92		47*		11,000
S138	15	1.5	10-May-07	<0.50	<0.25	0.53	6.2		560
S140	30	3.0	10-May-07	<0.50	<0.25	<0.50	13		440
s4	0.5-1.0	0.5-1.0	July 2006	Data not available	1.2*		36*		2800
s5	0.5-1.0	0.5-1.0			<0.25		59*		8300
s9	0.5-1.0	0.5-1.0			<0.25		10*		13000
s13	0.5-1.0	0.5-1.0			<0.25		3.4		4100
s14	0.5-1.0	0.5-1.0			0.54		30*		1900

NOTES

Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets.
 Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
 Sample Depth The depth of the XRF or laboratory sample from the ground surface in feet. GS means ground surface.
 mg/L milligrams per liter
 mg/kg milligrams per kilogram
 TCLP Toxic Characteristic Leaching Procedure EPA SW-846 Method 1311
 MCCTC Maximum Concentration of Contaminants for Toxicity Characteristic
BOLD and Right Indicates that the TCLP concentration of the metal exceeded the MCCTC

Laboratory Qualifiers

* Value exceeds the Maximum Concentration of Contaminants for Toxicity Characteristic

Table 9
Calculation of Site-Specific GPL for Lead and Cadmium
Ore Mill Site, City of Tucson

Cadmium			Lead		
Location	Depth ID	AWQS Laboratory (mg/Kg)	TCLP (mg/L)	LAB/TCLP	0.05 mg/L
s4	0.5-1.0	43	1.2	35.8	77.8
s5	0.5-1.0	6.4	<0.25	NA	140.7
s9	0.5-1.0	21	<0.25	NA	1300.0
s13	0.5-1.0	16	<0.25	NA	1205.9
s14	0.5-1.0	41	0.54	75.9	63.3
S131	10	70	1.6	43.8	110.0
S138	GS	44	0.92	47.8	234.0
S127	GS	8.8	<0.25	NA	154.8
S127	30	5.3	<0.25	NA	716.7
S122	GS	6.4	<0.25	NA	816.3
S127	45	5.5	<0.25	NA	3941.2

Cadmium Site Specific GPL 52.5 mg/Kg Lead Site Specific GPL 927.5 mg/Kg

From Guidance* $X_s = (292.9/r)(AWQS)$
Where - X_s is the site specific GPL
 r is the lowest ratio between the lab and TCLP data
AWQS is the Aquifer Water Quality Standard.

Notes

GPL Groundwater Protection Level
Location ID The "S" followed by three numbers in the Client Sample ID on the laboratory data sheets.
Depth ID The two digit number after the dash in the Client Sample ID on the laboratory data sheets.
AWQS Aquifer Water Quality Standard
mg/Kg milligrams per kilogram
TCLP Toxic Characteristic Leaching Procedure EPA SW-846 Method 1311
mg/L milligrams per liter
LAB/TCLP ratio between the lab and TCLP data
GS Ground surface
This table utilizes the results from select TCLP analysis from site investigations completed in 2006 and 2007.
S# or S## TCLP sample analyzed in July 2006
S### TCLP sample analyzed in May 2007

Source of Regulatory Concentrations

AWQS Arizona Administrative Code R10-11-406, January 4, 1986
A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality, Appendix C, September 1996
* Site Specific GPL

APPENDIX B

DETAILED COST DESCRIPTIONS FOR EACH REMEDIAL ALTERNATIVE

TABLE B-1
Alternative 1: No Action¹
City of Tucson
Former Ore Mill Site

Remediation Costs				
Item	Units	Quantity	Unit Cost	Total Cost
<i>No action</i>	N/A	0	\$0.00	\$0.00
Remediation Costs Subtotal				\$0.00
Annual Site Inspection and Monitoring Costs				
Item	Units	Quantity	Unit Cost	Total Cost
<i>No action</i>	N/A	0	\$0.00	\$0.00
Annual Site Inspection and Monitoring Costs Subtotal				\$0.00
Total Cost, Alternative 1				\$0.00
Note: ¹ Under Alternative 1, no action would be performed at the site beyond what the COT has already done with fencing and signage. The impacted soils would be left in place without any additional remedy. Costs for completion of 100% civil design and construction of the park are not included and would greatly be dependant upon input from the COT Parks Department.				

TABLE B-2
Alternative 2
Engineering and Land Use Controls¹
City of Tucson
Former Ore Mill Site



Remediation Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. Professional Services				
<i>a. Project Management and Community Support</i>				
Manage project financials and completion of contractor work. Provide a summary letter report of Engineering and LUCs implemented on-site. Assist the City with holding community meetings.	Lump sum	1	\$10,000.00	\$10,000.00
<i>b. On-site Oversight</i>				
Develop a Health and Safety Plan prior to commencing field work. Oversee installation of chain-link and slope erosion control.	Lump sum	1	\$10,000.00	\$10,000.00
<i>c. Deed Restriction Coordination</i>				
	Lump sum	1	\$7,000.00	\$7,000.00
<i>d. Park Design</i>				
Design costs have been included for remediation design and a park concept design ² .	Lump sum	1	\$60,000.00	\$60,000.00
2. Contracted Services				
<i>a. Contractor</i>				
Replace barbed wire fence with chain-link fence around the contamination footprints. Install slope erosion control.	Lump sum	1	\$57,500.00	\$57,500.00
Remediation Costs Subtotal				\$137,500.00
Annual Site Inspection and Monitoring Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. On-Site Inspection and Monitoring				
<i>a. Consultant Site Inspection and Dust Monitoring</i>				
Inspect site for signs of erosion. Inspect fence integrity. Perform air monitoring of COCs at the site (8 hour sample). Report investigation and monitoring results to COT.	Per Year	1	\$15,000.00	\$15,000.00
Total Cost, Alternative 2				\$153,000.00
Note:				
¹ Alternative 2 includes the utilization of engineering and LUCs to manage impacted materials at the former ore mill site exceeding the 400 mg/kg rSRL for lead. Engineering controls include installing a chain-link fence around the contamination footprints; permanent controls to prevent sediment erosion down the slope and into the wash adjacent to the site; long-term dust monitoring, and filing of a deed restriction on the property.				
² Costs for completion of 100% civil design and construction of the park are not included and would greatly be dependant upon input from the COT Parks Department.				

TABLE B-3
Alternative 3a: Excavate, Bury On-site, and Engineered Cap¹
City of Tucson
Former Ore Mill Site



Remediation Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. Professional Services				
a. <i>Project Management and Community Support</i> Manage project financials, project schedule, contractors and completion of remediation work. Assist the City with holding community meetings.	Lump sum	1	\$20,000.00	\$20,000.00
b. <i>On-site Oversight and Support</i> Oversee contractor activities in the field. Perform on-site health and safety monitoring, including daily air monitoring in and outside of the work area. Collect confirmational soil samples.	Lump sum	1	\$30,000.00	\$30,000.00
c. <i>Reporting and Analyses</i> Summary Report when the on-site work has been completed. Assist the COT with regulatory agency negotiations and preparing a DEUR application along with the required \$25,250 fee ² (included in estimated cost).	Lump sum	1	\$60,000.00	\$60,000.00
d. <i>Geotechnical Engineering</i> Perform test pits and collect subsurface soil samples to verify depth (and total volume) of contamination on the slope.	Lump sum	1	\$15,000.00	\$15,000.00
e. <i>Laboratory analyses</i> Analyze and report Confirmational Soil Samples (RCRA 6010/7471)	Lump sum	1	\$4,000.00	\$4,000.00
f. <i>Aerial topographic survey</i> A more detailed topographic aerial survey, to a resolution of 0.5-foot, would be obtained to properly plan for the remediation and grading design.	Lump sum	1	\$75,000.00	\$75,000.00
g. <i>Dust Permit</i> Preparation/submittal of application and fee	Lump sum	1	\$1,500.00	\$1,500.00
h. <i>404 Jurisdictional Delineation (JD) and Permit</i> Perform a JD and determine permit applicability. Cost conservatively assumes a Nation Wide Permit (NWP) would <u>not</u> be issued, requiring a specific permit instead.	Lump sum	1	\$90,000.00	\$90,000.00
i. <i>Construction Storm Water Pollution Prevention Plan (SWPPP)</i> Develop plan and submit notices	Lump sum	1	\$6,000.00	\$6,000.00
j. <i>Asbestos clearing and reporting</i> Inspect/sample concrete footings for clearance of asbestos. Cost assumes that concrete does not contain asbestos.	Lump sum	1	\$2,000.00	\$2,000.00
k. <i>Remediation, Grading and Park Design</i> Costs have been included for design of the engineered cap, surface grading, drainage and a park <u>concept</u> ³ .	Lump sum	1	\$60,000.00	\$60,000.00
2. Construction Services				
a. <i>Environmental contractor</i> Excavate the north slope, flat area south of the mill, and above ground concrete debris. This material would be buried in an excavated pit on the east side. A 2.5ft engineered cap would be installed over the remaining contamination footprint and pit from an off-site source. The surrounding topography would be modified to create 1% graded side slopes to the capped area. This estimate does not include the costs of landscaping for the final park design.	Lump sum	1	\$387,228.00	\$387,228.00
Remediation Costs Subtotal				\$750,728.00
Annual Site Inspection and Monitoring Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. On-Site Inspection and Monitoring				
a. <i>Consultant Site Inspection and Dust Monitoring</i> Inspect site for signs of erosion or exposed consolidated materials. Report investigation and monitoring results to COT.	Per Year	1	\$15,000.00	\$15,000.00
Annual Site Inspection and Monitoring Costs Subtotal				\$15,000.00
Total Cost, Alternative 3a				\$766,000.00
Note: ¹ Alternative 3a involves excavating the north slope, flat area south of the mill, and above ground concrete debris. This material would be buried in an excavated pit on the east side. A 2.5ft engineered cap would be installed over the remaining contamination footprint and pit from an off-site source. It is assumed that borrow pit material can be used to backfill the flat area on the south end and the north slope. Also assume the surrounding topography can be modified to create 1% graded side slopes to the capped area. A deed restriction would be filed on the property. ² DEUR fee assumes a maximum 30 year life of the property. ³ Costs for completion of 100% civil design and construction of the park are not included and would be greatly dependant upon input from the COT Parks Department.				

TABLE B-4
Alternative 3b: Excavate, Consolidate, and Cap¹
City of Tucson
Former Ore Mill Site



Remediation Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. Professional Services				
<i>a. Project Management and Community Support</i> Manage project financials, project schedule, contractors and completion of remediation work. Assist the City with holding community meetings.	Lump sum	1	\$20,000.00	\$20,000.00
<i>b. On-site Oversight and Support</i> Oversee contractor activities in the field. Perform on-site health and safety monitoring, including daily air monitoring in and outside of the work area. Collect confirmational soil samples.	Lump sum	1	\$30,000.00	\$30,000.00
<i>c. Reporting and Analyses</i> Summary Report when the on-site work has been completed. Assist the COT with regulatory agency negotiations and preparing a DEUR application along with the required \$25,250 fee ² (included in estimated cost).	Lump sum	1	\$60,000.00	\$60,000.00
<i>d. Geotechnical Engineering</i> Verify depth of contamination on the slope and collect subsurface soil samples for lab testing of soil strength parameters.	Lump sum	1	\$15,000.00	\$15,000.00
<i>e. Laboratory analyses</i> Analyze and report Confirmational Soil Samples (RCRA 6010/7471)	Lump sum	1	\$4,000.00	\$4,000.00
<i>f. Aerial topographic survey</i> A more detailed topographic aerial survey, to a resolution of 0.5-foot, would be obtained in the acreage within the building foundations to determine an exact volume available for the consolidated materials to be contained and capped.	Lump sum	1	\$20,000.00	\$20,000.00
<i>g. Dust Permit</i> Preparation/submittal of application and fee	Lump sum	1	\$1,500.00	\$1,500.00
<i>h. 404 Jurisdictional Delineation (JD) and Permit</i> Perform a JD and determine permit applicability. Cost conservatively assumes a Nation Wide Permit (NWP) would not be issued, requiring a specific permit instead.	Lump sum	1	\$90,000.00	\$90,000.00
<i>i. Construction Storm Water Pollution Prevention Plan (SWPPP)</i> Develop plan and submit notices	Lump sum	1	\$6,000.00	\$6,000.00
<i>j. Asbestos clearing and reporting</i> Inspect/sample concrete footings for clearance of asbestos. Cost assumes that concrete does not contain asbestos.	Lump sum	1	\$2,000.00	\$2,000.00
<i>k. Remediation, Grading and Park Design</i> Costs have been included for design of the engineered cap, surface grading, drainage and a park <u>concept</u> ³ .	Lump sum	1	\$60,000.00	\$60,000.00
2. Construction Services				
<i>a. Environmental contractor</i> Excavate contaminated footprint, consolidate material in the building foundations, demolish above ground concrete structures, install demarcation, and import clean fill for cap. Grade the site and install slope erosion controls per engineering plans. Install impervious surface (asphalt/concrete) above the mill site foundation and on the face of the north slope. Replace fence around the area. This estimate does not include the costs of landscaping for the final park design.	Lump sum	1	\$556,554.00	\$556,554.00
Remediation Costs Subtotal				\$865,054.00
Annual Site Inspection and Monitoring Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. On-Site Inspection and Monitoring				
<i>a. Consultant Site Inspection and Dust Monitoring</i> Inspect site for signs of erosion or exposed consolidated materials. Report investigation and monitoring results to COT.	Per Year	1	\$15,000.00	\$15,000.00
Annual Site Inspection and Monitoring Costs Subtotal				\$15,000.00
Total Cost, Alternative 3b				\$880,000.00
Note: ¹ Alternative 3b involves the excavation of materials at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The excavated materials would be consolidated and placed in the former building foundations and other existing depressions nearby. The consolidated area and excavated slope would be capped with soil and an impervious (i.e. concrete, asphalt) material. Demolition may be necessary to prepare the area for grading and the eventual soil and asphalt or concrete cap. A deed restriction would be filed on the property. ² Fee assumes a maximum 30 year life of the property. ³ Costs for completion of 100% civil design and construction of the park are not included and would be greatly dependant upon input from the COT Parks Department.				

TABLE B-5
Alternative 4
Excavate, Stabilize, and Transport Off-Site for Disposal¹
City of Tucson
Former Ore Mill Site

Remediation Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. Professional Services				
<i>a. Project Management and Community Support</i> Manage project financials, project schedule, contractors and completion of remediation work. Assist the City with holding community meetings.	Lump sum	1	\$25,000.00	\$25,000.00
<i>b. On-site Oversight and Support</i> Oversee contractor activities in the field. Perform on-site health and safety monitoring, including daily air monitoring in and outside of the work area. Collect confirmational soil samples.	Lump sum	1	\$30,000.00	\$30,000.00
<i>c. Reporting and Analyses</i> Develop Health and Safety Plan, Sampling and Analysis Plan, Quality Assurance Plan prior to commencing work. Assist the COT-ES with regulatory agency negotiations and correspondence. Develop and submit a Site Closure Report.	Lump sum	1	\$20,000.00	\$20,000.00
<i>d. Geotechnical Engineering</i> Perform test pits and collect subsurface soil samples to verify depth (and total volume) of contamination on the slope.	Lump sum	1	\$15,000.00	\$15,000.00
<i>e. Laboratory analyses</i> Analyze and report Confirmational Soil Samples (RCRA 6010/7471) and Disposal Characterization Soil Samples (TCLP)	Lump sum	1	\$13,200.00	\$13,200.00
<i>f. Dust Permit</i> Preparation/submittal of application and fee	Lump sum	1	\$1,500.00	\$1,500.00
<i>g. 404 Jurisdictional Delineation (JD) and Permit</i> Perform a JD and determine permit applicability. Cost conservatively assumes a Nation Wide Permit (NWP) would <u>not</u> be issued, requiring a specific permit instead.	Lump sum	1	\$90,000.00	\$90,000.00
<i>h. Construction Storm Water Pollution Prevention Plan (SWPPP)</i> Develop plan and submit notices	Lump sum	1	\$6,000.00	\$6,000.00
<i>i. Asbestos clearing and reporting</i> Inspect/sample concrete footings for clearance of asbestos. Cost assumes that concrete does not contain asbestos.	Lump sum	1	\$2,000.00	\$2,000.00
<i>j. Park Design</i> Costs have been included for design of the surface grading, drainage and a park concept ² .	Lump sum	1	\$60,000.00	\$60,000.00
2. Construction Services				
<i>a. Environmental contractor</i> Excavate contaminated footprint and treat the excavated material so that Toxicity Characteristic Leaching Procedure (TCLP) concentrations are below hazardous waste thresholds. Demolish above ground concrete structures and dispose all material to a Subtitle D landfill. Import clean fill for cap. Grade the site and install slope erosion controls per engineering plans. This estimate does not include the costs of landscaping for the final park design.	Lump sum	1	\$1,581,756.00	\$1,581,756.00
Remediation Costs Subtotal				\$1,844,456.00
Annual Site Inspection and Monitoring Costs				
Item	Units	Quantity	Unit Cost	Total Cost
1. On-Site Inspection and Monitoring				
<i>a. Consultant Site Inspection and Dust Monitoring</i> Not necessary, as COCs are removed from the site.	Per Year	1	\$0.00	\$0.00
Annual Site Inspection and Monitoring Costs Subtotal				\$0.00
Total Cost, Alternative 4				\$1,845,000.00
Note:				
¹ Alternative 4 would call for the excavation of materials at the former ore mill site exceeding the 400 mg/kg rSRL for lead. The excavated materials (conservatively estimate 7,200 cy) would be consolidated and stabilized using a phosphate amendment for lead in a temporary storage area on-site. Remaining building foundations will be demolished and incorporated into the excavation materials. All waste materials demolished and excavated/stabilized would be transported off-site to a licensed waste disposal facility. Clean fill would be placed, compacted and graded per the grading and drainage plan. No deed restriction would need to be filed on the property.				
² Costs for completion of 100% civil design and construction of the park are not included and would be greatly dependant upon input from the COT Parks Department.				